

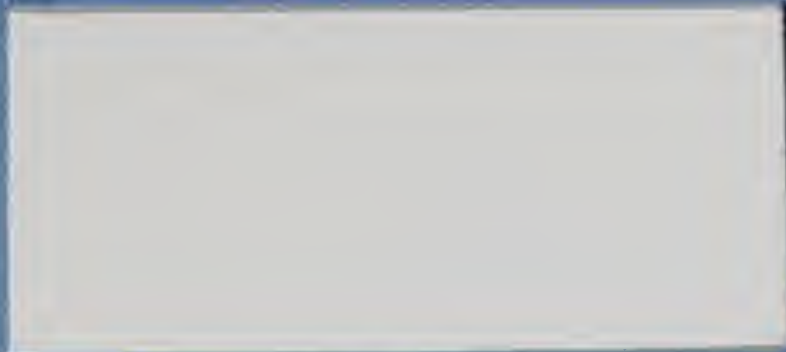
BLM LIBRARY



88057576

OFFICE COPY
DO NOT REMOVE

NOV 23 1984



TN
B39
.C64
C3713
1974
c.3



88057576

TN
859
C64
C3713
1974
C.3

BLM Library
D-553A, Building 50
Denver Federal Center
P. O. Box 25047
Denver, CO 80225-0047

FEDERAL OIL SHALE
PROTOTYPE LEASING PROGRAM
TRACT C-b
SUPPLEMENTAL EXPLORATION PLAN

ELI LILLY
P.O. BOX 2000
GREENVILLE, SC 29602-0200
P. O. BOX 2000
DENVER FEDERAL CENTER
DENVER, CO 80202-0200

FEDERAL OIL SHALE PROTOTYPE LEASING PROGRAM

TRACT C-b

SUPPLEMENTAL EXPLORATION PLAN

Submitted to:

Mr. George H. Horn
Acting Mining Supervisor
Conservation Division
U. S. Geological Survey
Lakewood, Colorado

By:

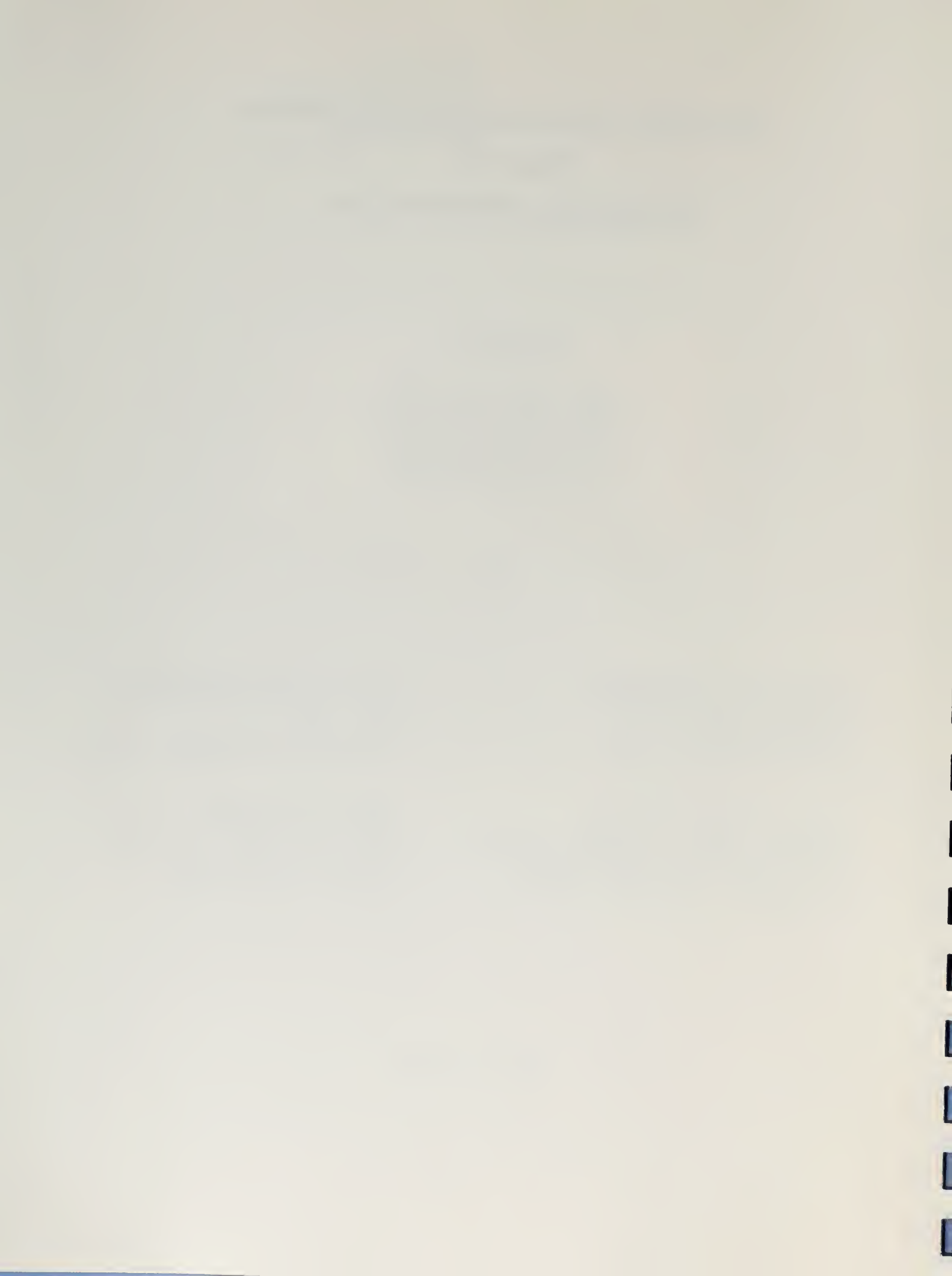
Ashland Oil, Incorporated
Synthetic Oil Department
P. O. Box 391
Ashland, Kentucky 41101

The Oil Shale Corporation
10100 Santa Monica Boulevard
Suite 1600
Los Angeles, California 90067

Atlantic Richfield Company
Synthetic Crude & Minerals Division
P. O. Box 2679, Terminal Annex
Los Angeles, California 90071

Shell Oil Company
Mining Ventures Department
P. O. Box 2099
Houston, Texas 77001

May 16, 1974



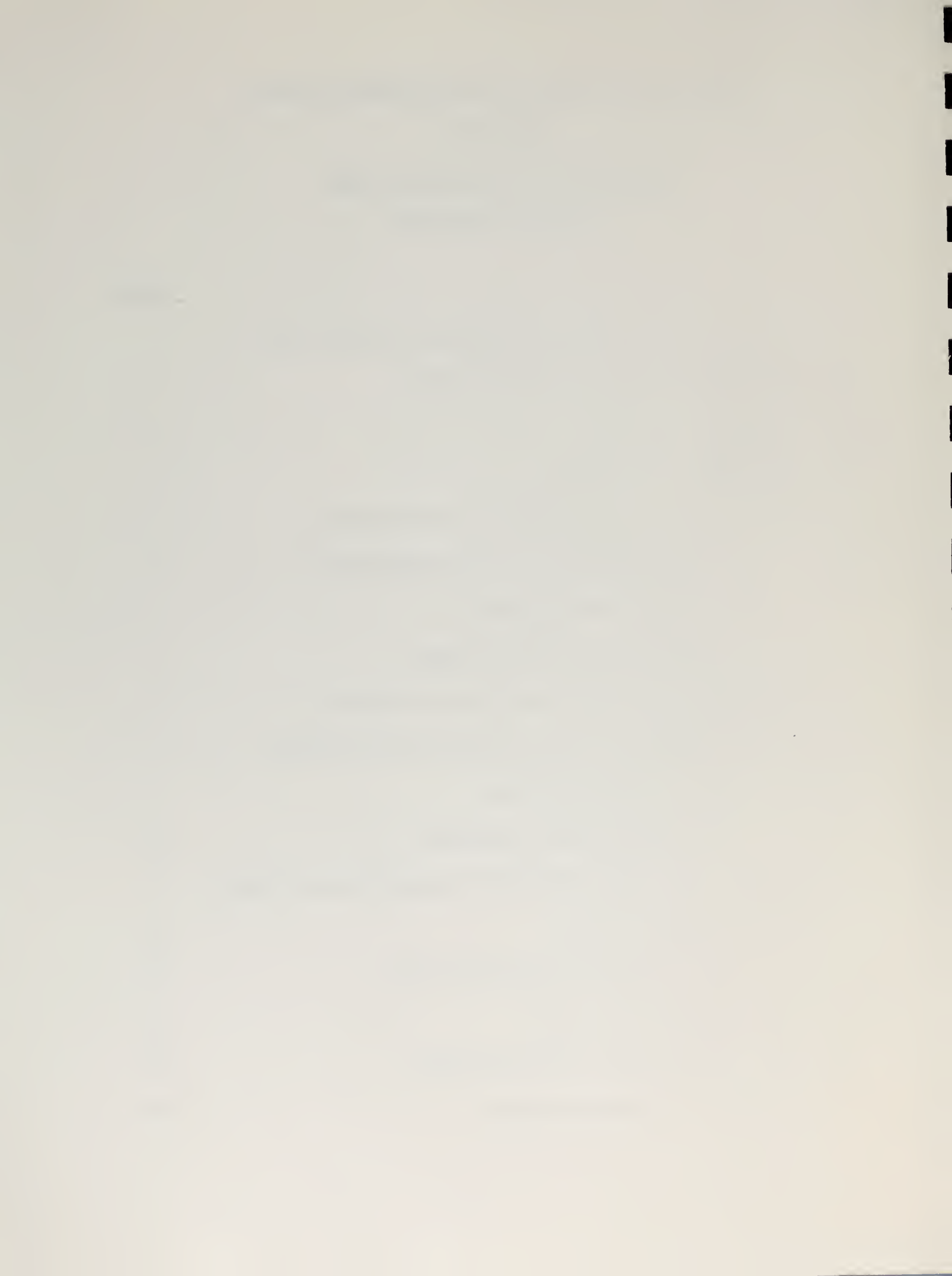
FEDERAL OIL SHALE PROTOTYPE LEASING PROGRAM

TRACT C-b

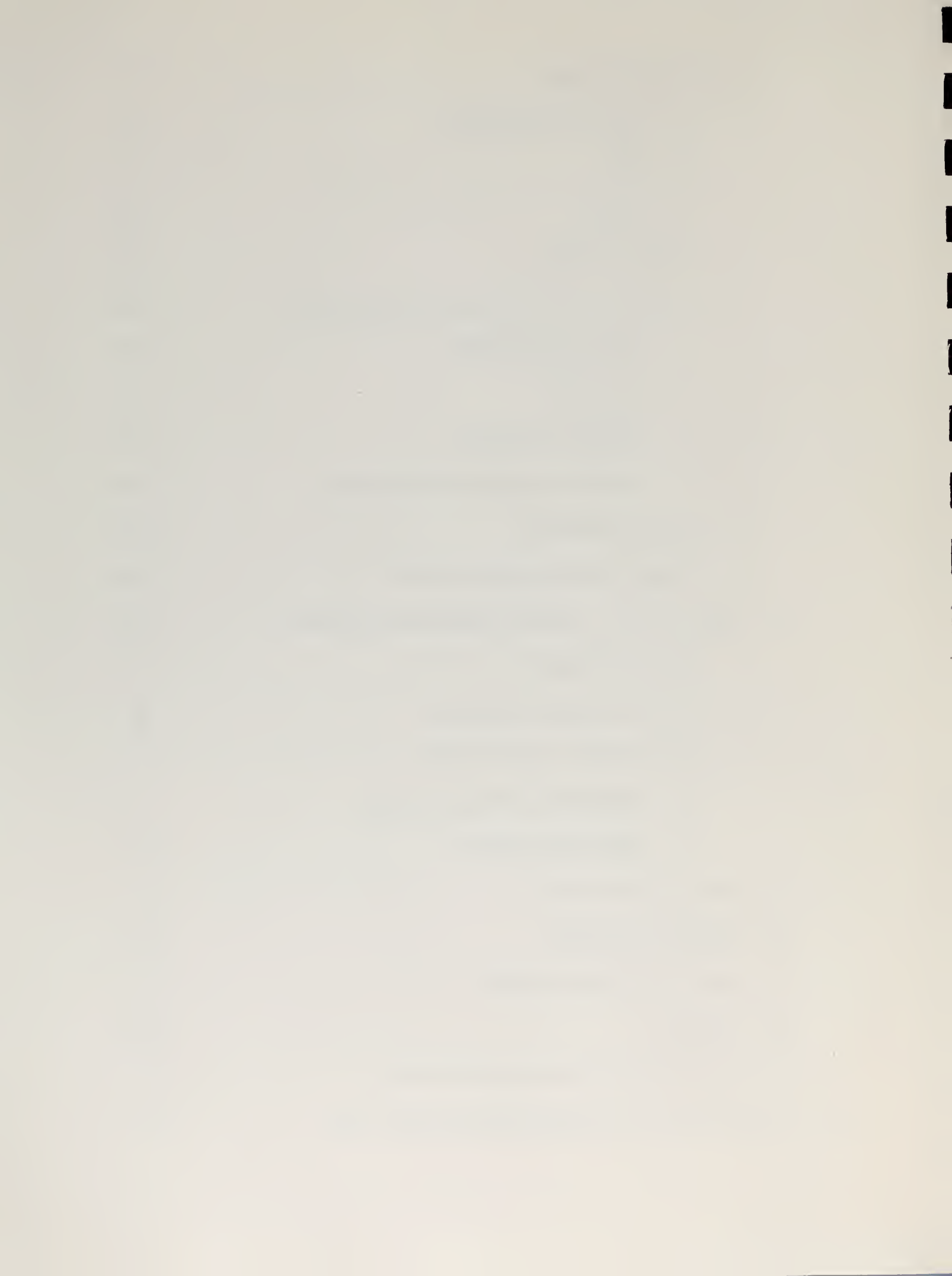
SUPPLEMENTAL EXPLORATION PLAN

TABLE OF CONTENTS

	<u>Page</u>
I. Introduction and Summary of Proposed Exploration Plan	1
II. Description and Location of Lease Tract	2
III. Request for Approval	2
IV. Description of Programs	4
A. Pre-Exploration Environmental Investigations	4
1. Plant and Animal Ecology Investigations	4
2. Aquatic Reconnaissance	5
3. Archaeological Considerations	5
B. Environmental Baseline Monitoring Programs	6
1. Surface and Ground Water Sampling Programs	6
a. Surface Hydrology	6
b. Ground Water Hydrology	10
2. Air Quality and Meteorological Sampling Program	13
a. Air Quality	13
b. Climatology and Meteorology	14
c. Work Schedule	14
d. Duties of Field Personnel	16
e. Additional Studies	16



3.	Flora and Fauna	18
a.	General Coordination	18
b.	Flora	19
c.	Fauna	20
4.	Aquatic Ecology	23
5.	Soils Survey and Productivity Assessment	25
a.	Chemical Properties	25
b.	Soil Water	25
c.	Physical Properties	25
d.	Structural-engineering Properties	26
6.	Scenic Resources	27
7.	Historic and Scientific Values	28
C.	Roads, Trails, and Other Necessary Facilities	29
1.	Roads and Trails	29
2.	Other Necessary Facilities	29
3.	Other Surface Disturbances	31
a.	Rehabilitation Research Plots	31
b.	Water Improvement	32
D.	Cross Country Travel	33
E.	Research Operations	33
F.	Seismic Work and Blasting	33
G.	Drilling	33
V.	Initial Fish and Wildlife Management Plan	35
VI.	Erosion Control and Surface Rehabilitation Plan	35



TRACT C-b
FEDERAL OIL SHALE PROTOTYPE LEASING PROGRAM
SUPPLEMENTAL EXPLORATION PLAN

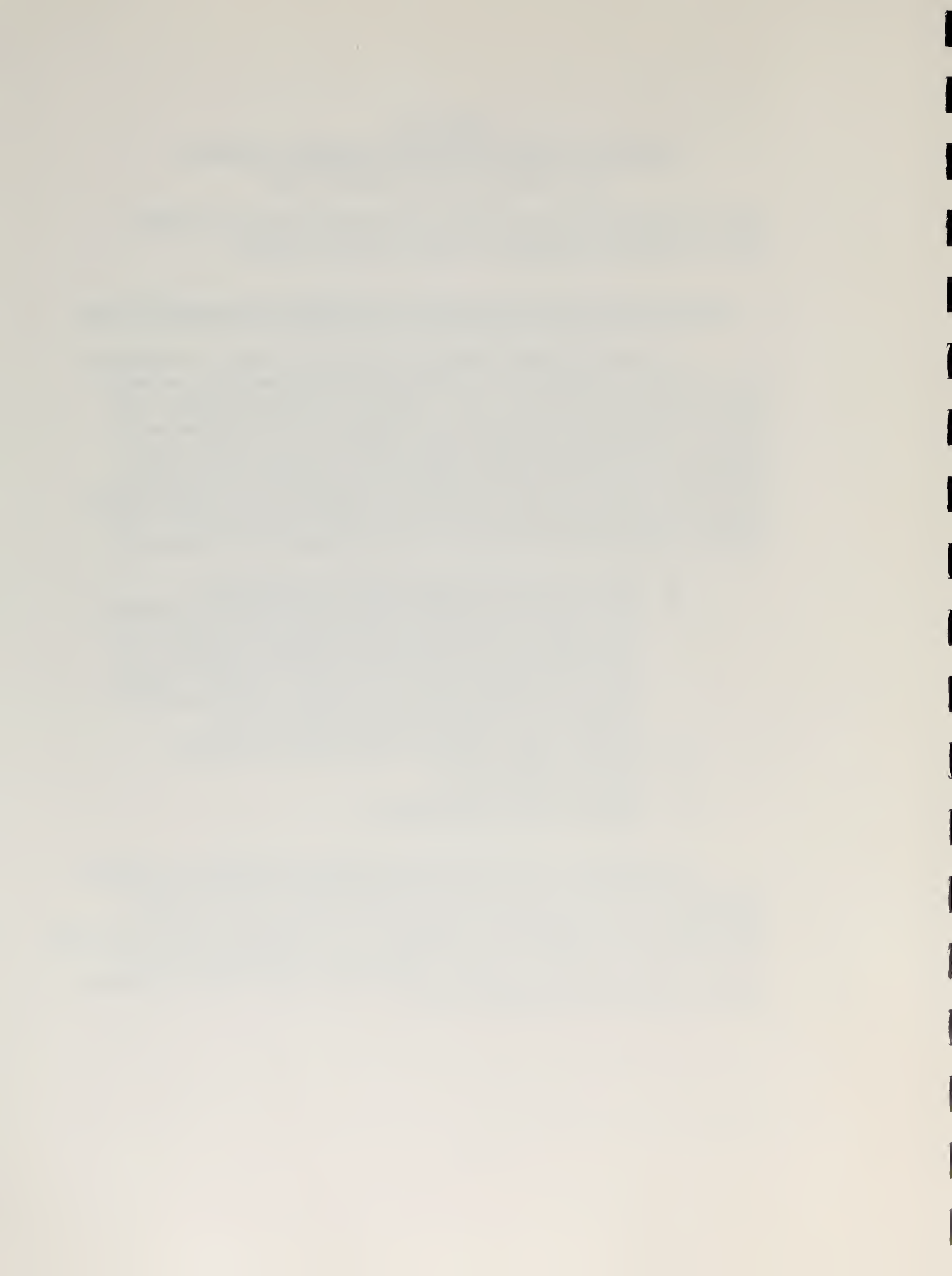
(Filed pursuant to Section 10(d) of the Oil Shale Lease (C-20341)
under the Federal Prototype Oil Shale Leasing Program)

I. INTRODUCTION AND SUMMARY OF PROPOSED EXPLORATION PLAN

This Supplemental Exploration Plan ("the Plan") is submitted by the Operator for Tract C-b, Atlantic Richfield Company, on behalf of the Lessees; Ashland Oil, Inc., Atlantic Richfield Company, The Oil Shale Corporation, and Shell Oil Company, in compliance with Section 10 (d) of the Oil Shale Lease dated March 18, 1974. This Supplemental Exploration Plan together with the initial Exploration Plan filed on April 10, 1974, contains a description of all exploratory programs presently contemplated by the Operator on Tract C-b. The programs proposed to be carried out on or adjacent to the Tract are:

- A. Pre-Exploration Environmental Investigations
- B. Environmental Baseline Monitoring Programs; including (1) Surface and Ground Water Sampling Program, (2) Air Quality and Meterological Sampling Program, (3) Flora and Fauna Studies, (4) Aquatic Ecology, (5) Soil Survey and Productivity Assessment, (6) Scenic Resources, (7) Historic and Scientific Values.
- C. Roads, Trails, and Other Necessary Facilities
- D. Cross-Country Travel
- E. Research Operations
- F. Seismic Work and Blasting

In addition to the foregoing environmental programs, Operator has included in Sections V and VI its preliminary Fish and Wildlife Management Plan and Rehabilitation Plan which will be initially applicable to the exploratory field work. It is expected that these plans will continually evolve as environmental data is obtained and will result in final complete and long range Plans which will be submitted with the Detailed Development Plan.



II. DESCRIPTION AND LOCATION OF LEASE TRACT

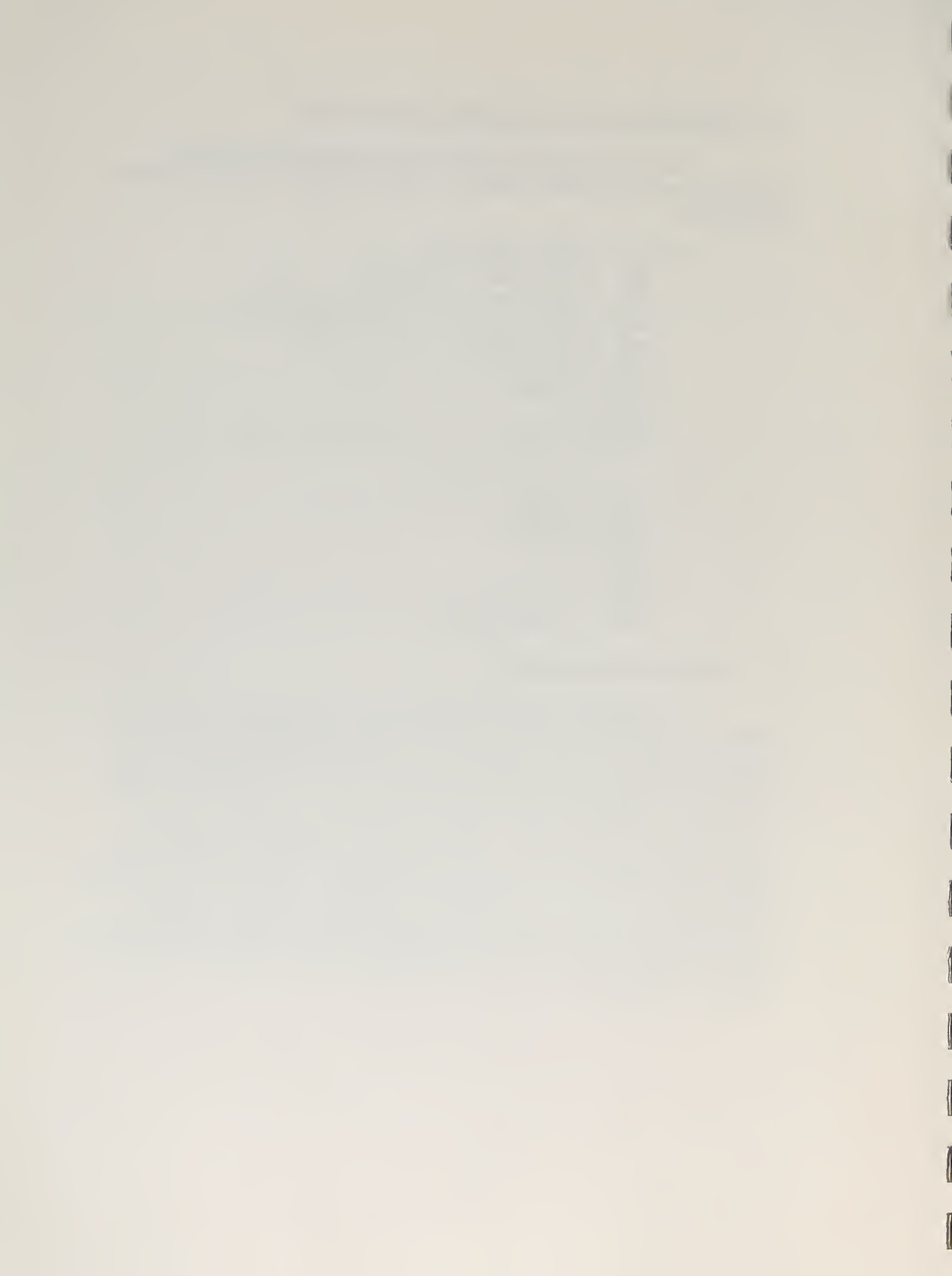
This Plan applies to Tract C-b of The Federal Oil Shale Prototype Leasing Program which is shown in Figure 1 and is located as follows:

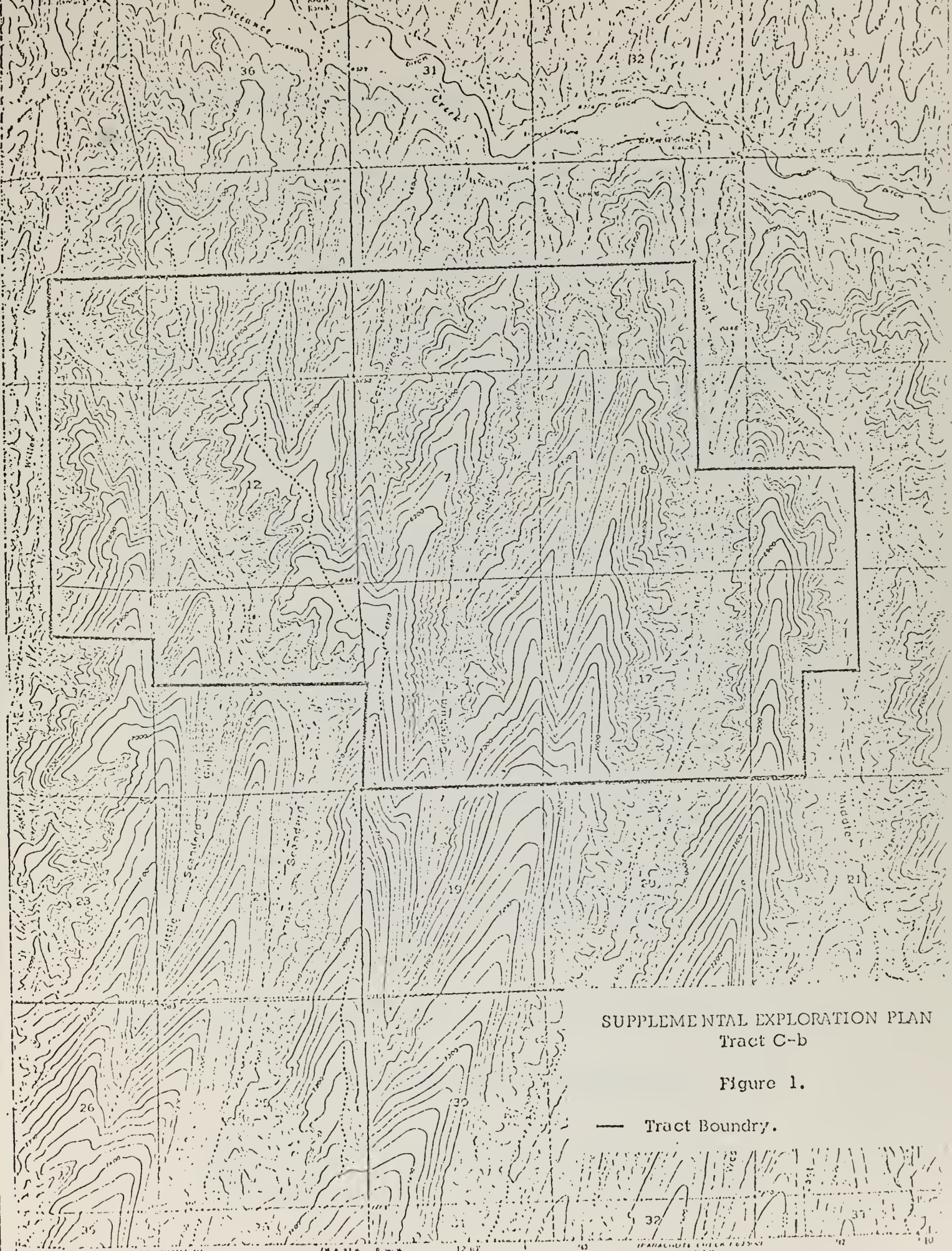
T. 3.S., R.96W., 6th P.M.
Sec. 5, W1/2 SE1/4, SW1/4;
Sec. 6 lots 6 and 7, E1/2 SW1/4, SE1/4;
Sec. 7, lots 1, 2, 3, 4, E1/2, W1/2, E1/2;
Sec. 8, W1/2 NE1/4, NW1/4, S1/2;
Sec. 9, SW1/4;
Sec. 16, NW1/4, W1/2, SW1/4;
Sec. 17;
Sec. 18, lots 1, 2, 3, 4, E1/2W1/2, E1/2.

T. 3.S., R.97W., 6th P.M.
Sec. 1, S1/2;
Sec. 2, SE1/4;
Sec. 11, E1/2;
Sec. 12;
Sec. 13, N1/2;
Sec. 14, N1/2 NE1/4.

III. REQUEST FOR APPROVAL

The Operator requests approval of this Plan by the Mining Supervisor by June 1, 1974, in order to take advantage of the summer months to conduct field studies and to obtain baseline data for the present growing season prior to submission of the Detailed Development Plan currently scheduled for Fall of 1975. In order for Operator to organize, schedule, and commence field work by mid-summer, timely approval is required. Upon request, Operator is prepared to discuss in further detail the programs proposed herein with the Mining Supervisor, the Environmental Advisory Panel, or others suggested by the Mining Supervisor. In particular, Operator will be pleased to present these programs and be available for discussion or questioning at the Advisory Panel meeting scheduled for May 16 and 17, 1974, in Rangely, Colorado.





SUPPLEMENTAL EXPLORATION PLAN
Tract C-b

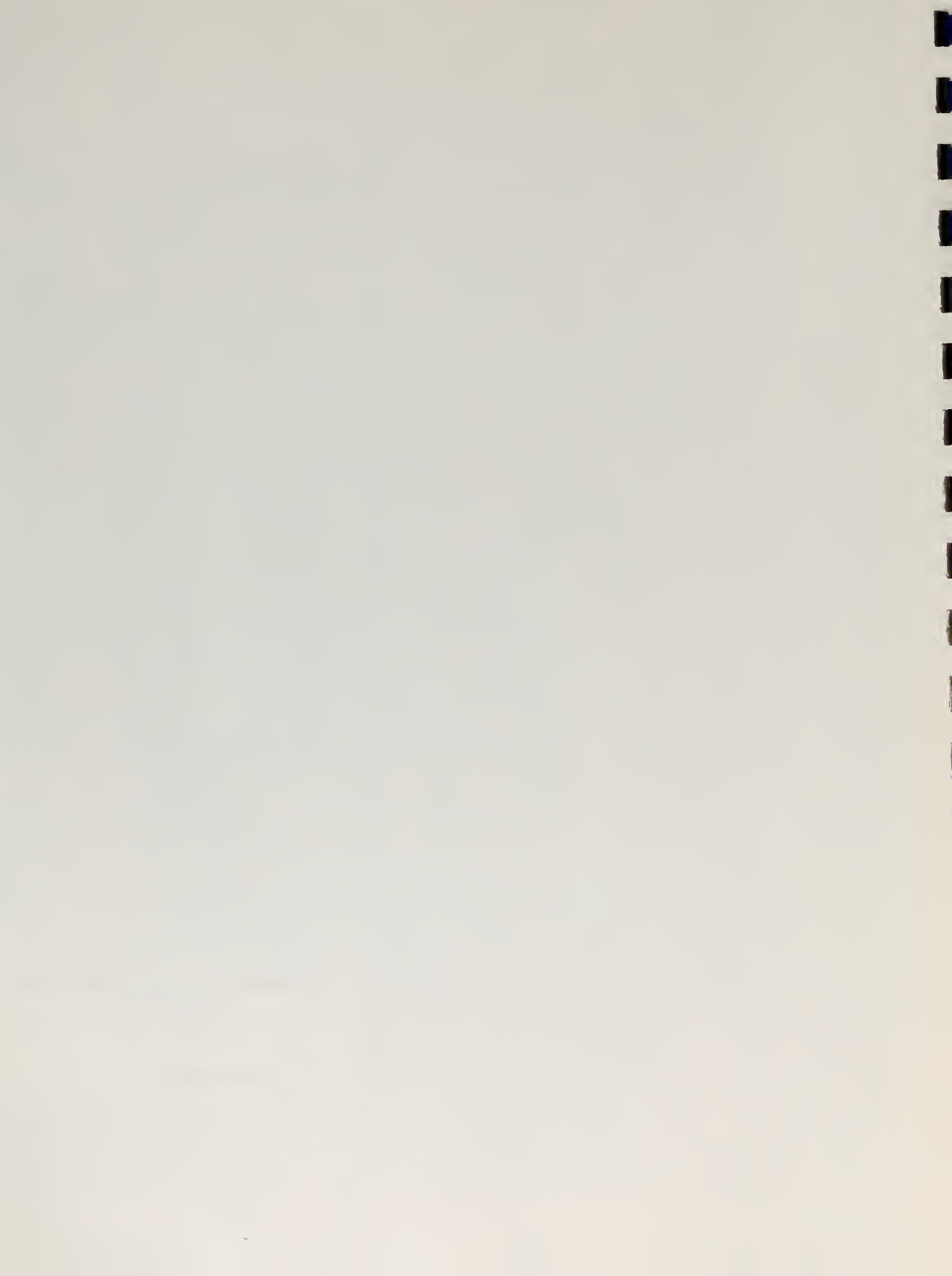
Figure 1.

— Tract Boundary.

Map made, edited, and published by the Geological Survey
 under authority of the Department of the Interior
 and the Department of the Army
 Copyright, 1922, by the United States Government
 Printed and published by the Geological Survey
 Washington, D. C.



-3-
 SCALE 1:24,000
 UNITED STATES GEOLOGICAL SURVEY
 WASHINGTON, D. C.



IV. DESCRIPTION OF PROGRAMS

The content, methodology, organization, timing, personnel, and on-site equipment related to the programs proposed to be carried out by Operator are described below:

A. Pre-Exploration Environmental Investigations

The Operator will conduct investigations of conditions existing on the proposed sites of exploration and monitoring programs prior to the initiation of specific activities to conform with the environmental considerations of the Lease and to avoid undue environmental damage from the Exploration Programs. These investigations are not substitutes for the required environmental baseline data collection and monitoring programs, but are in addition thereto.

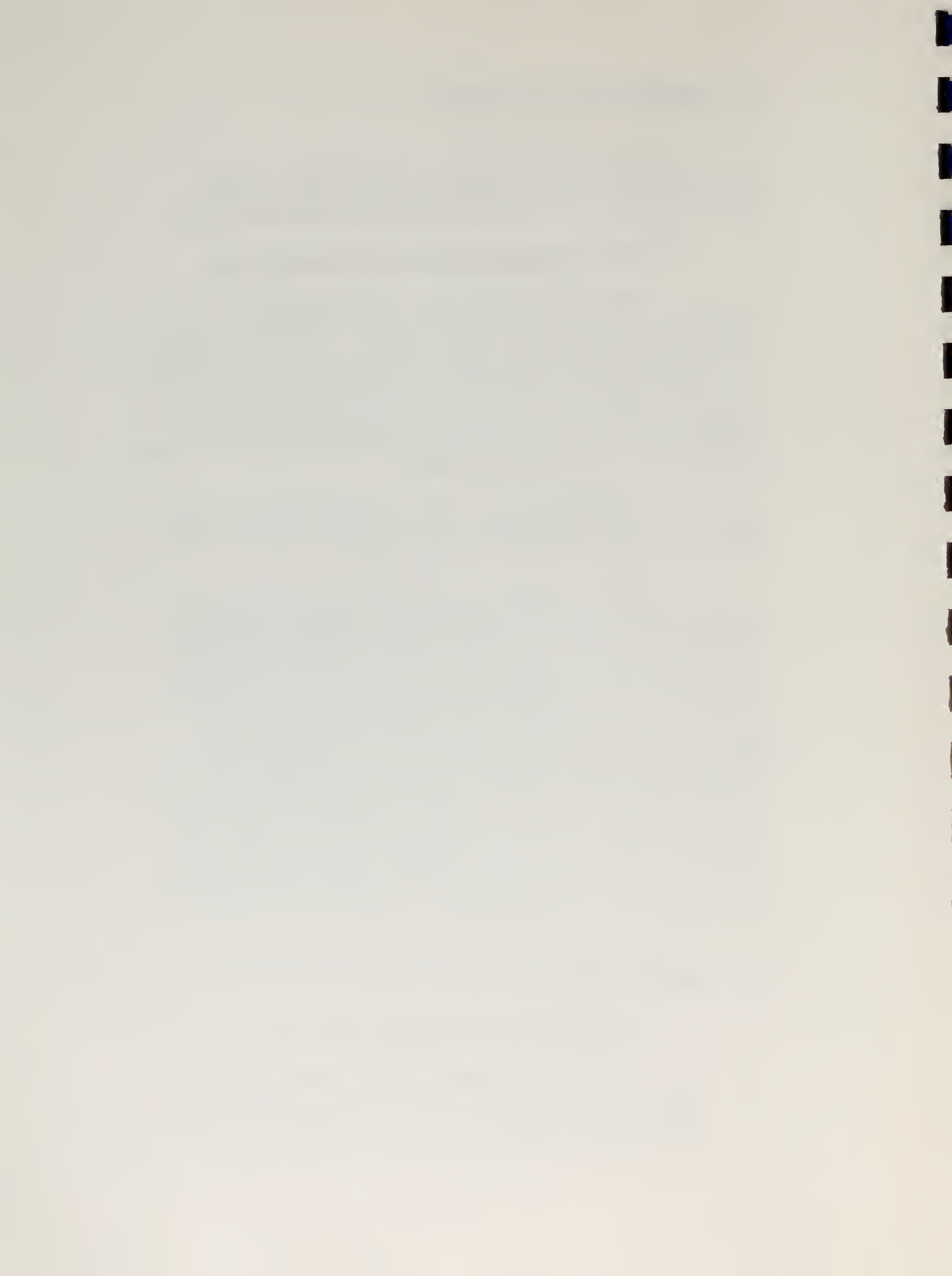
The principal areas of field investigations planned pertain to: plant and animal ecology, aquatic ecology, and historic and archaeological considerations.

The main objective of these studies is to provide adequate environmental data prior to the exploratory disturbances contemplated to avoid and mitigate surface disturbance or destruction of environmental values. The plant and animal survey will provide information about the type and conditions of flora and fauna existing on the areas which will be disturbed. The information will assist in the rehabilitation of these areas after the exploration phase is completed. The studies will identify any rare or scientifically significant species or special features of interest such as springs or objects of historic interest. The Mining Supervisor will be immediately informed of any such species or special features found. Even though the total extent of disturbance is quite small compared to the size of the Tract, the Operator recognizes that these initial studies should be performed.

Specific objectives and the scope of work for these studies are outlined below:

1. Plant and Animal Ecology Investigations

These investigations will be directed at drill sites and proposed clearing areas, water monitoring stations, air monitoring stations, and utility and support facilities. Plant communities present will be



inventoried and their condition described. The investigations will note rare or ecologically significant species found, map the community types or sites, and evaluate habitat significance. Major animal species present on, or supported by, sites will be inventoried and their abundance described. The investigation will include a list of major species, and describe rare or unique species on, or dependent on, the site. The effect of the temporary loss of the habitat will be evaluated. A general evaluation of major impacts, if any, caused by slight improvement and increased use of roads will be made. The investigation will include an on-site survey of each area to be disturbed.

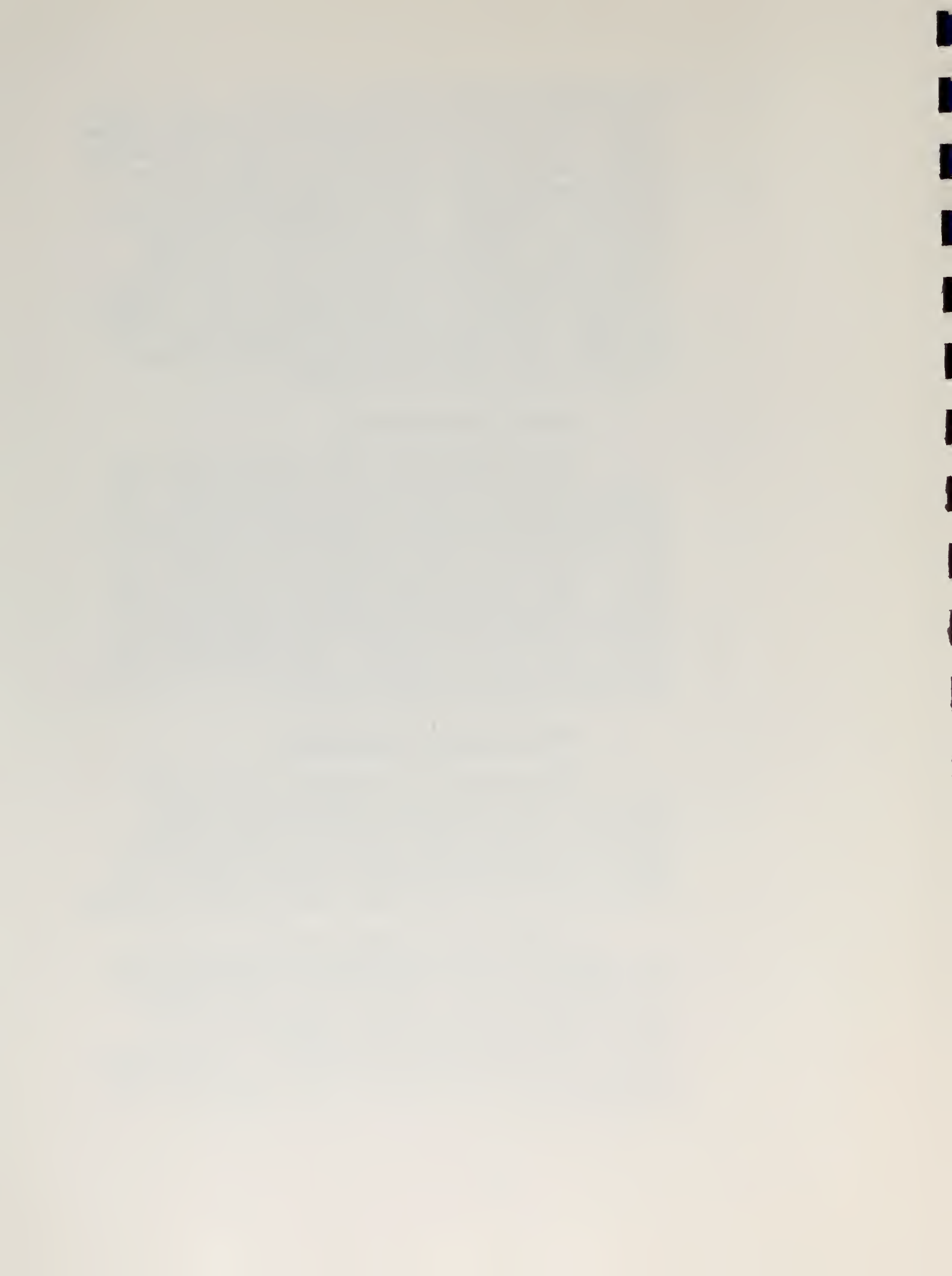
2. Aquatic Reconnaissance

The objective is to obtain water quality and aquatic ecology information prior to disturbance. The study will include a list of fish species present in each stream and estimates of their size and abundance. Major invertebrate groups present will be listed. A list of major algae species present will also be compiled. Water quality data including temperature, pH, dissolved oxygen (DO), turbidity, and total dissolved solids (TDS) will be gathered. The investigation will include representative sampling of streams for organisms and algae and water quality sampling.

3. Archaeological Considerations

The objective is to determine, prior to disturbance, whether proposed exploration sites have historical or archaeological significance and whether proposed activities would impact on archaeological features. The study will include a surface survey of exploration sites and roads which will be used or improved.

A report will be prepared listing by location any artifacts, or any archaeological or historical sites of significance found. Any sites with high potential for archaeological or historical significance will be noted. The significance of any artifacts, sites, or potential sites found will be evaluated. A recommended course of action will be made for any significant sites discovered.



B. Environmental Baseline Monitoring Programs

1. Surface and Ground Water Sampling Program

a. Surface Hydrology

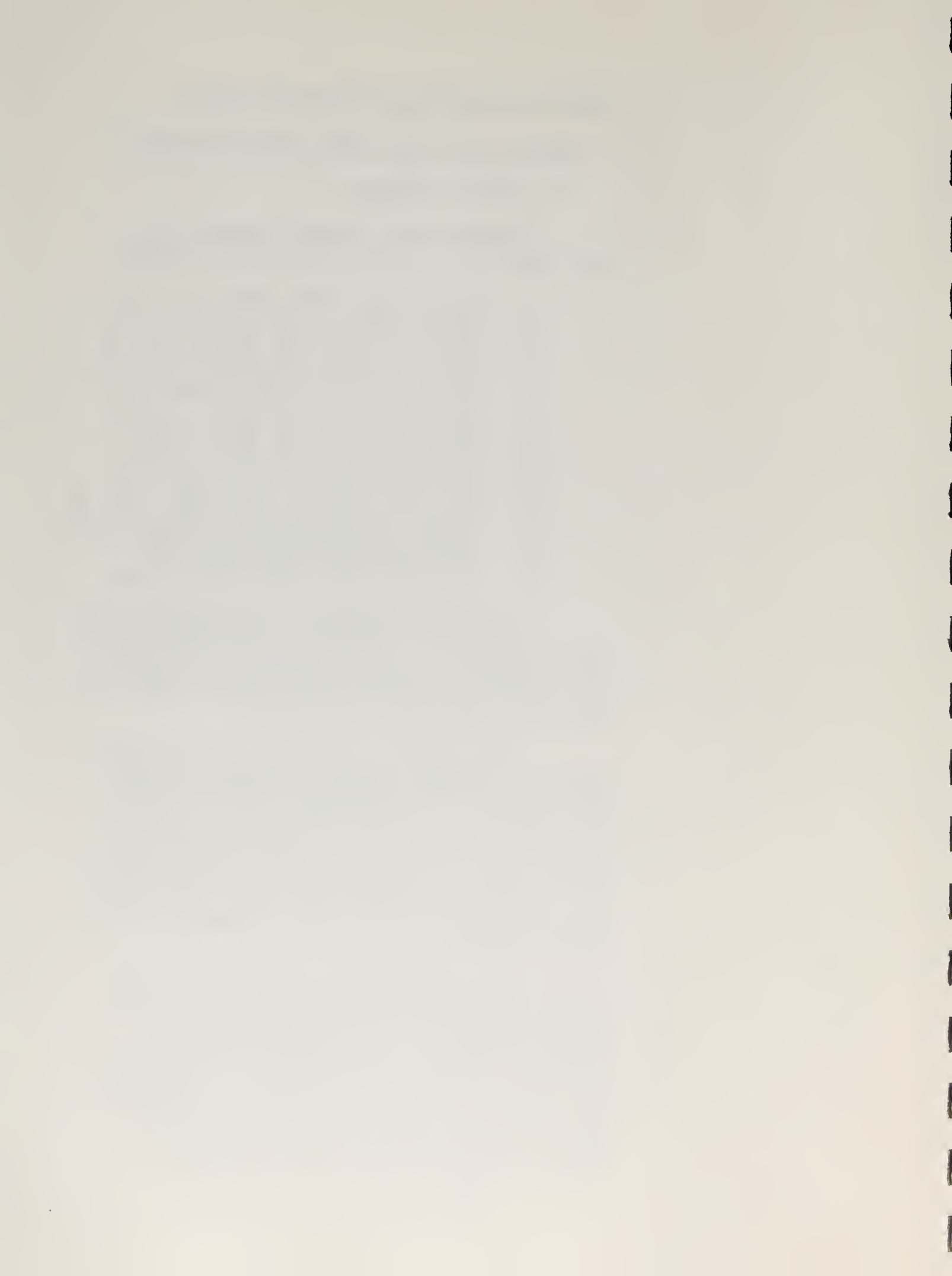
The USGS has installed thirteen water monitoring stations on or near the Tract as follows:

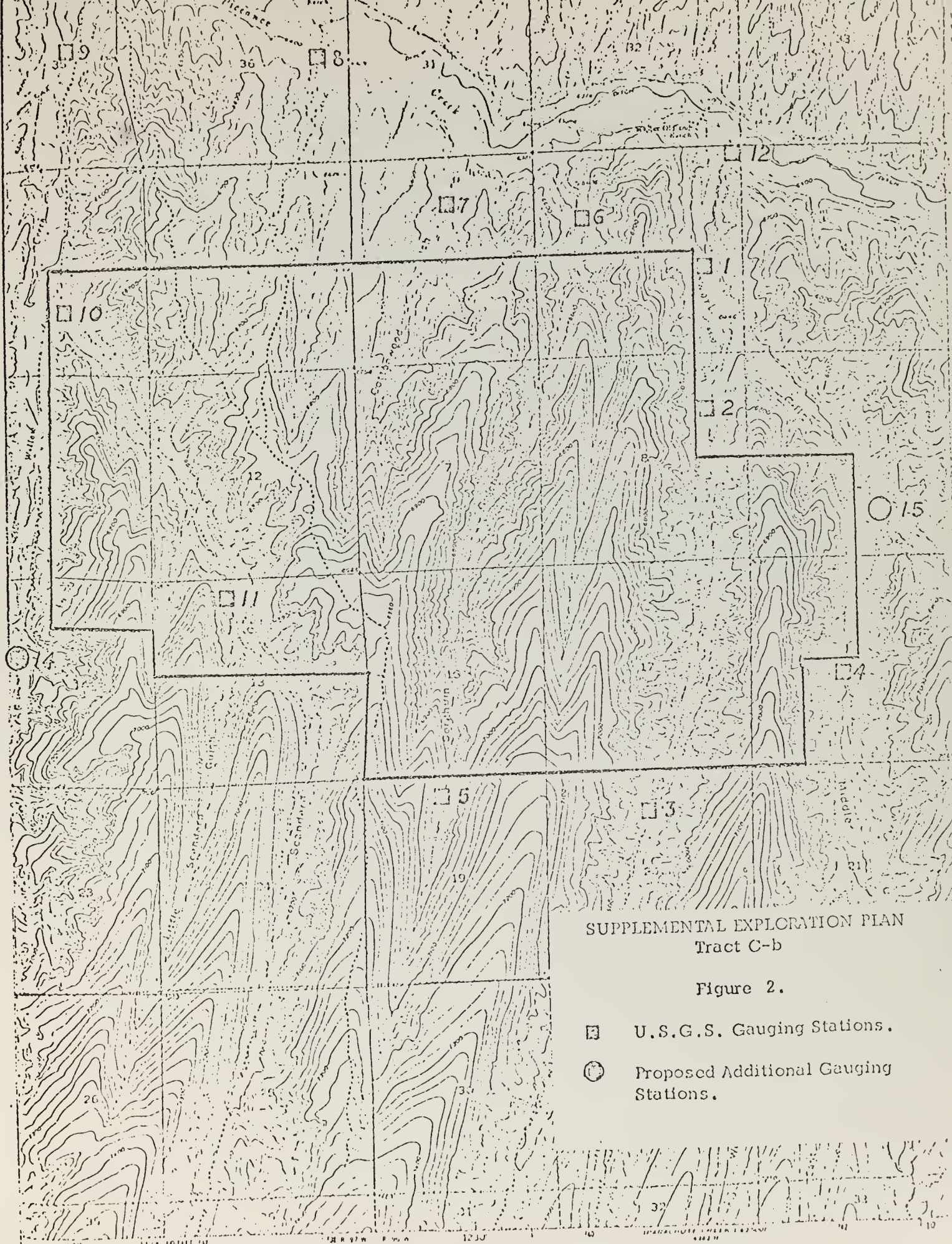
- i. Willow Creek, T2S, R97W, sec. 35
- ii. Scandard Gulch, T3S, R97W, sec. 2
- iii. Scandard Gulch, T3S, R97W, sec. 13
- iv. Unnamed Gulch, T2S, R97W, sec. 36
- v. Cottonwood Gulch, T3S, R96W, sec. 6
- vi. Sorghum Gulch, T3S, R96W, sec. 5
- vii. Sorghum Gulch, T3S, R96W, sec. 19
- viii. Stewart Gulch, T3S, R96W, sec. 5
- ix. West Fork Stewart, T3S, R96W, sec. 8
- x. West Fork Stewart, T3S, R96W, sec. 20
- xi. Middle Fork Stewart, T3S, R96W, sec. 16
- xii. Piceance Creek near Storey Gulch
- xiii. Piceance Creek below Willow Creek

Approximate locations of these stations are shown in Figure 2. The locations of these stations were selected to monitor all significant inflows to and outflows from the Tract and Piceance Creek upstream and downstream of the Tract.

Upon approval of this Plan by the Mining Supervisor, Operator expects to contract with the USGS through the Colorado River Water Conservation District, for the cost of the existing stations and for the operation of the sampling program described below. In addition to the existing stations two addition stations shown in Figure 2 may be added depending upon the initial evaluation of data existing stations.

Each surface water gauging station will include instruments for measuring continuous records of stream flow, water temperature and specific conductance. In addition, each station will have an automatic suspended sediment sampler for periodical sediment determinations. Precipitation records will be obtained as part of the Air Quality and Meteorological Programs described in Section IV (G) (2) (a) through (e) of this Plan.



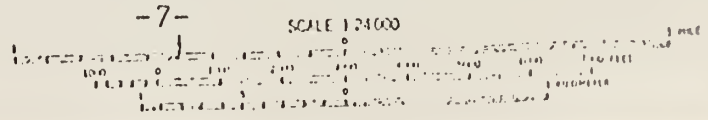


SUPPLEMENTAL EXPLORATION PLAN
Tract C-b

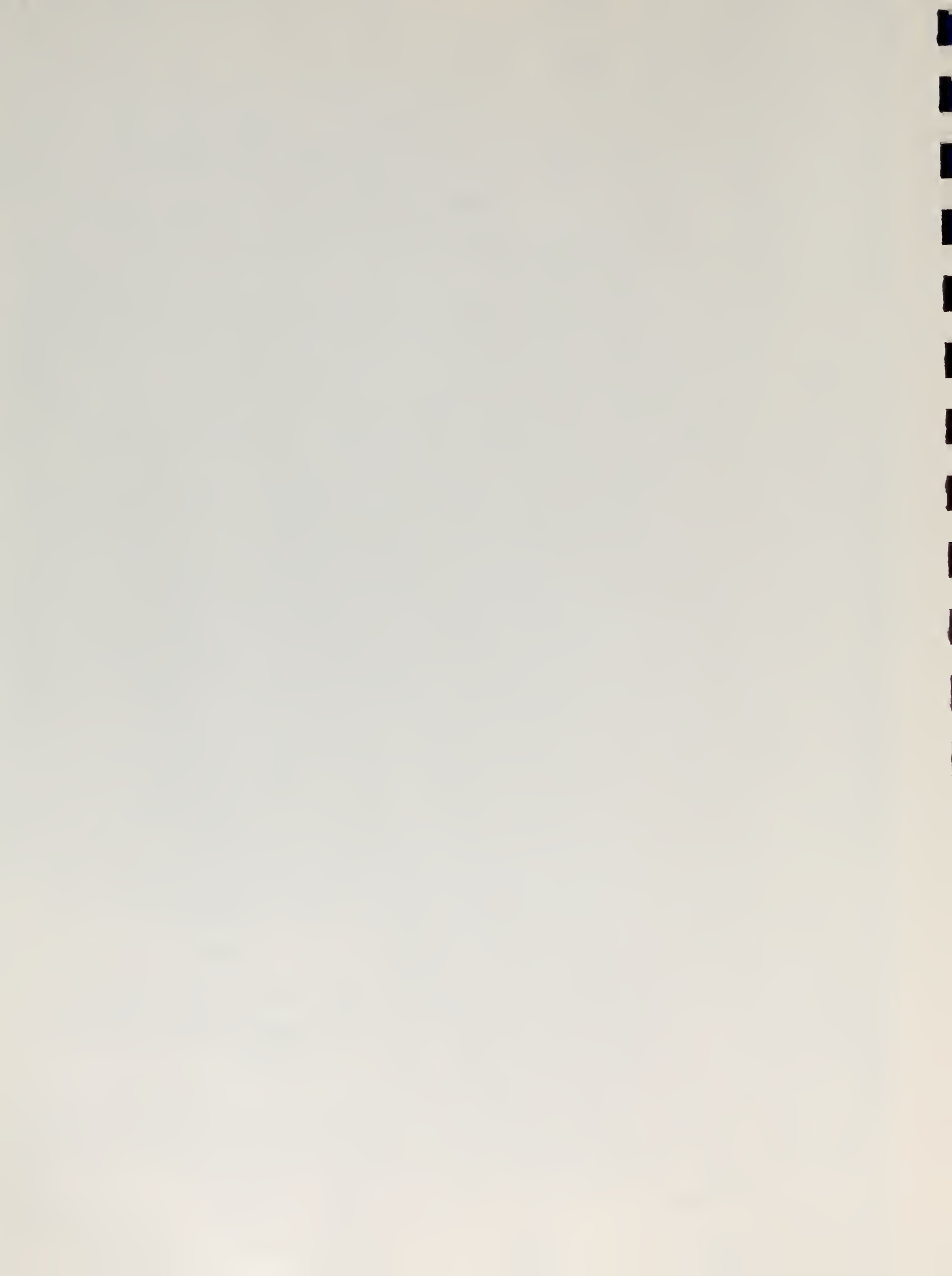
Figure 2.

- ☐ U.S.G.S. Gauging Stations.
- Proposed Additional Gauging Stations.

Maped, edited, and published by the Geological Survey
 control by USGS and USGS
 The original base map was prepared by multiple methods
 from topographic data taken in 1911 and 1912
 The map projection is the North American datum
 1960 foot grid based on datum to avoid scale system



CONTINENTAL SHEET



The water quality sampling program is designed to be in accordance with Federal and State standards. The initial analyses to be performed and tentative sample frequency is shown in Table 1. The USGS plans to take samples quite frequently in the beginning of the program and then after sufficient data are available, an ongoing analysis detail and frequency of sampling will be recommended.

The Operator will maintain records of all surface water information obtained and will make such data available to the Mining Supervisor, Colorado State Engineer, EPA, Colorado River Water Conservation District and the Colorado Department of Health.

An on-site laboratory for use by USGS and Operator will be equipped to measure BOD, acidity-alkalinity, cyanide, oil and grease, phenolics and threshold odor. The laboratory will also have pH and dissolved oxygen testing equipment and necessary standardizing reagents.

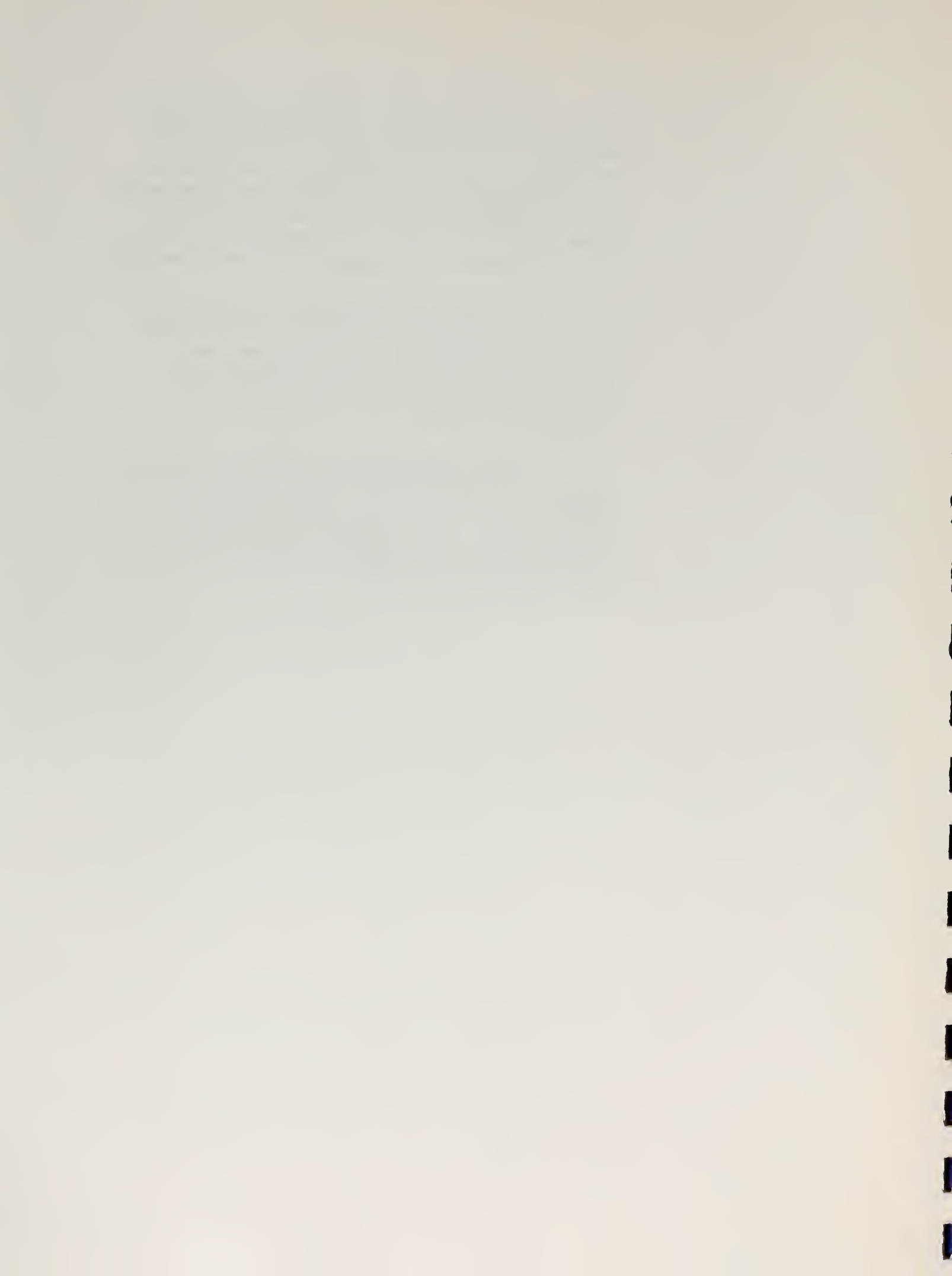
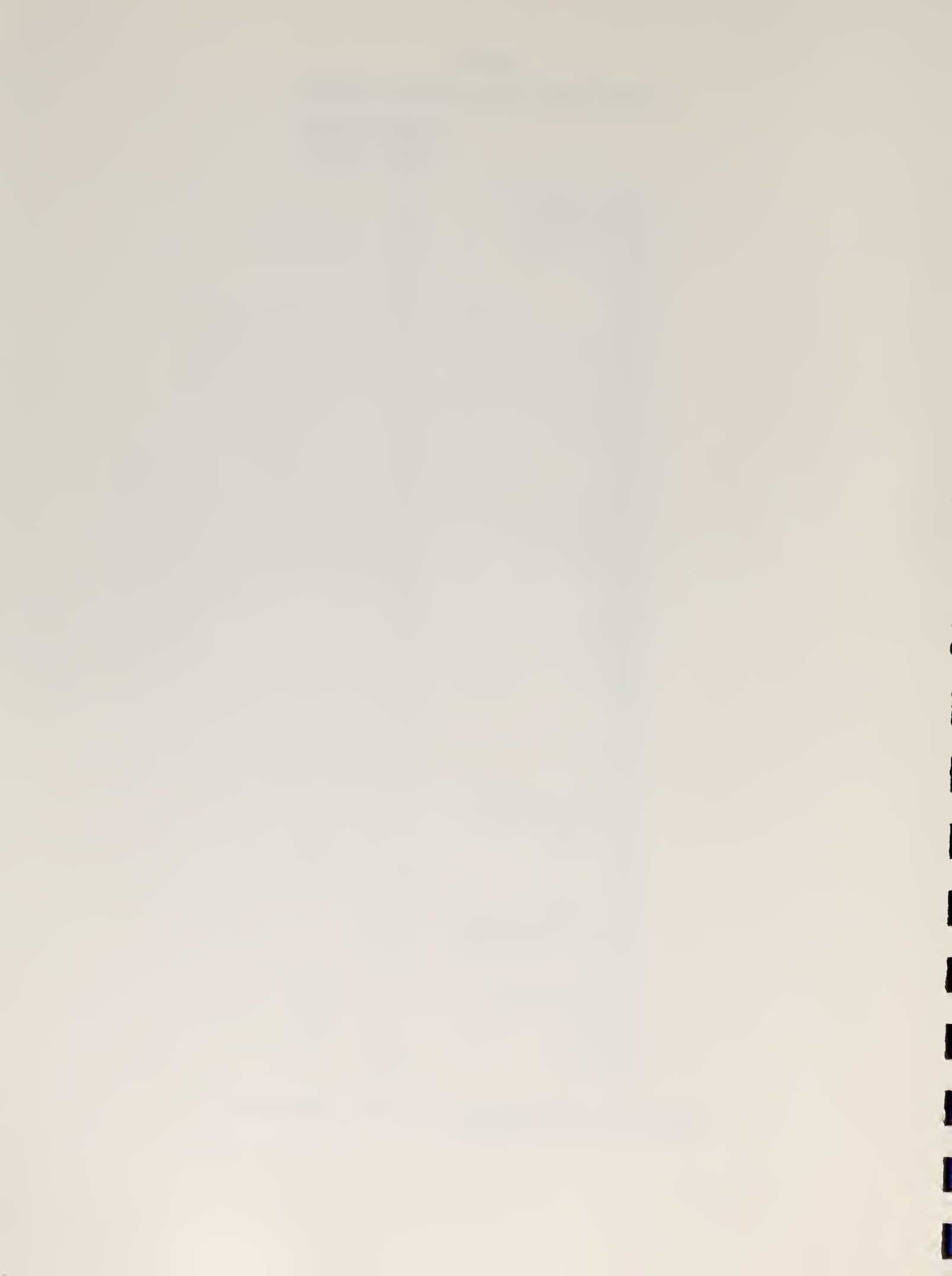


TABLE 1

SURFACE WATER QUALITY ANALYTICAL PROGRAM

	<u>All Surface Waters</u>	
	<u>Semi-</u>	<u>Semi-</u>
	<u>Monthly</u>	<u>Annually</u>
Specific Conductivity	x	
Dissolved Solids	x	
Suspended Solids	x	
Dissolved Oxygen	x	
pH	x	
Turbidity	x	
Color	x	
Odor	x	
Silica	x	
Calcium	x	
Magnesium	x	
Sodium	x	
Potassium	x	
Ammonia	x	
Cyanide	x	
Sulfate	x	
Sulfide	x	
Nitrate	x	
Nitrite	x	
Phosphate	x	
Chloride	x	
Carbonate	x	
Bicarbonate	x	
Fluoride	x	
Lithium	x	
Barium	x	
Chromium	x	
Arsenic	x	
Selenium	x	
Cadium	x	
Copper	x	
Boron	x	
Iron	x	
Lead	x	
Manganese	x	
Silver	x	
Zinc	x	
Complete element scan for all trace elements		x
Gross Alpha*		x
Gross Beta *		x
COD	x	
BOD	x	
Oil & Grease	x	
Carbon Chloroform Extract	x	
Coliform, Total & Fecal	x	
Alkyl Benzene Sulfonate	x	
Phenols	x	
Amines		x
Polycyclic Aromatics		x
Pesticides		x
Asbestos		x
Mercury	x	
Beryllium	x	
Molybdenum	x	

*Depending on count, thorium 230, radium 226, strontium 90 and natural uranium may be required.

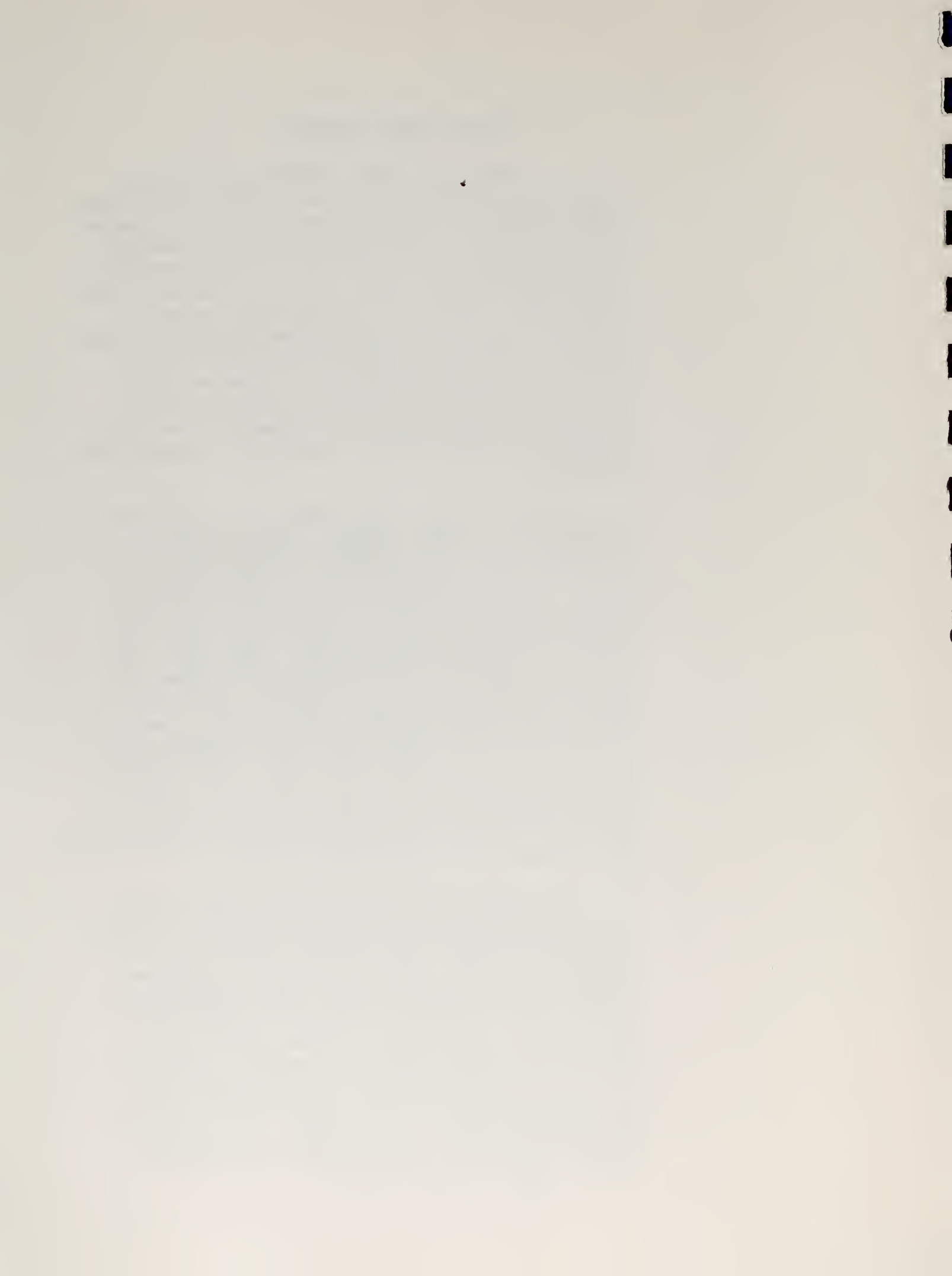


b. Ground Water Hydrology

The ground water hydrology study is important to both environmental and mining considerations. Large quantities of ground water may have to be pumped from the vicinity of the underground mining zone prior to and during mining operations. If this is necessary, responsible handling and/or disposal of this water will be required. The effect of ground water removal on surface water and upon communicating aquifers, if any, must be determined. Information pertaining to both quantity and quality of underground water as well as transmissivity and flow rates must be developed to evaluate the magnitude of these potential impacts and to determine what mitigation steps may be necessary or desirable.

At the proposed initial mine site, a multi-well hydrologic test ("leaky aquifer" test) is planned as described in the "Core Drilling and Associated Ground Water Program" Plan filed with the USGS on April 10, 1974. This test is designed to obtain continuous discharge data from the water-bearing zones above and below the Mahogany Mining Zone. Water level fluctuations in each zone will be monitored in observation wells surrounding the large diameter test well for determination of transmissivity and the storage coefficient. These data are necessary before any meaningful water evaluations can be made on the Tract. Water samples will be taken during the drilling and testing of these wells to determine water quality from both aquifers and to detect the intercommunication, if any, between aquifers. The analyses planned are those in Table 1.

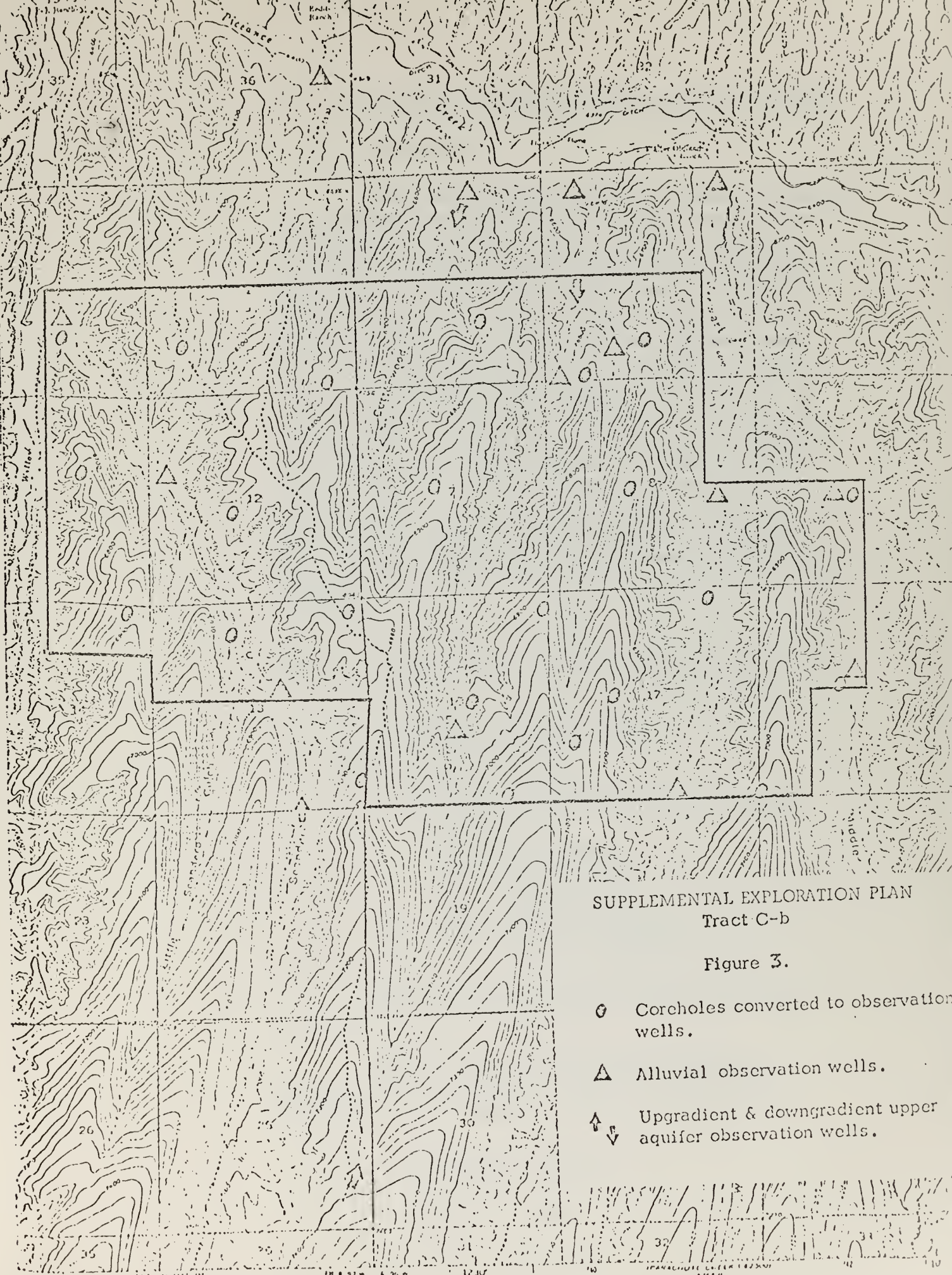
The second part of the Operator's ground water program is to utilize the proposed completed core holes previously described in the April 10, 1974 Plan submitted to the USGS, (up to 17 planned) for permanent ground water observation wells. These observation wells will give approximate uniform coverage of the Tract and will separately record fluctuating water levels in the aquifers above and below the Mahogany Zone. Water quality samples will be obtained and analyzed at least every six months to determine baseline data and trends in water quality. The Operator plans to obtain the same analyses as proposed for surface water samples (Table 1).



The third part of the ground water program is to complete observation wells upgradient and downgradient from potential spent shale surface disposal sites. There will be two wells upgradient from potential spent shale disposal areas, one which will penetrate the alluvium only while the other will penetrate through the upper aquifer. Downgradient there will also be a well through the alluvium as well as a well which will penetrate through the upper aquifer. These wells and the existing nearby core hole observation wells are designed to show the presence of any leachate that might escape from the spent shale disposal area. Should there be any leachate, it would be expected to show up in the alluvial wells. These observation wells will be drilled as close as possible to the northern and southern boundaries of the Tract along Sorghum Gulch and other potential disposal sites. If approved by the proper authorities, the Operator also plans to complete a shallow alluvial well off the Tract near the downstream gauging stations on major drainages.

These alluvial wells are designed to check on the direction and movement of alluvial water, the quality and quantity of water within the alluvial aquifer, and how this water ties into the spring and deeper aquifer system. Four inch plastic pipe will be used as casing in the alluvial wells. The alluvial observation wells described above are to be located approximately as shown on figure 3. These wells will be monitored on the same time scale and for the same consultants as the other observation wells.

All of the hydrologic data obtained from the core holes as well as aquifer tests and observation holes plus all available regional water data will be used in an aquifer computer simulation model. The model will extend these data to determine the effects dewatering will have on one or both aquifers as well as on all other parts of the hydrologic system.

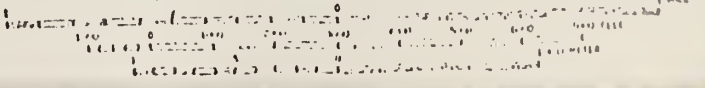


SUPPLEMENTAL EXPLORATION PLAN
Tract C-b

Figure 3.

- Corcholes converted to observation wells.
- △ Alluvial observation wells.
- ↑ ↓ Upgradient & downgradient upper aquifer observation wells.

Map-d, edited, and published by the Geological Survey
 Control by U.S.S. and U.K. S.U.S.
 Assembly from aerial photographs by multiple methods
 Aerial photographs taken 1944. Field check 1952



2. Air Quality and Meteorological Sampling Program

a. Air Quality

Baseline ambient air quality will be monitored for at least two consecutive full years through the use of four strategically located stations. The characteristics of the Tract are currently being analyzed by the Operator to determine where these four stations should be located to collect the most meaningful baseline data. One of the stations will be located at or near the expected point of maximum concentration. The Operator is presently determining the expected point of maximum concentrations for various meteorological conditions. A fifth station, designed primarily for the meteorological baseline data collection, will be used to house a complete set of extra air quality monitoring instruments. These extra instruments will collect data and will be available for immediate replacement in the event of instrument failures at any one of the other four primary monitoring stations.

At least four of the five trailers will monitor ambient concentrations of each of the following:

- i. Suspended particulates
- ii. Sulfur dioxide
- iii. Hydrogen sulfide
- iv. Meteorological data will be obtained including:
 - (A) Wind speed
 - (B) Wind direction
 - (C) Temperature
 - (D) Relative humidity
 - (E) Total precipitation

The instruments used to obtain this data will conform to EPA regulations.

Additionally, at least one of the five stations will also monitor ambient concentrations of each of the following:

- i. Total hydrocarbons
- ii. Methane
- iii. Carbon monoxide
- iv. Ozone
- v. Oxides of nitrogen

These instruments will also comply with applicable EPA regulations.

Each of the five trailers will contain equipment designed to gather, store, record, and process ambient air quality data. In addition, annual reports for averaging periods set forth in applicable Federal and State air quality regulations and the Lease requirements will be prepared for each contaminant and meteorological condition being sampled.

b. Climatology and Meteorology

As required by the Lease Stipulations, baseline meteorological data will be monitored for two consecutive full years. In addition to the information to be gathered at each trailer location, data will be collected from four levels (ground level, 30-feet above ground level, 100-feet above ground level, and 200-feet above ground level), by means of a 200-foot meteorological tower to be located in reasonable proximity to the proposed plant site.

At each of the four levels on the meteorological tower, the following parameters will be monitored:

- i. Wind direction
- ii. Wind speed
- iii. Relative humidity
- iv. Temperature

Meteorological data gathering equipment will be installed in one trailer to gather, store, record, and process baseline data.

c. Work Schedule

Phase I - May 1 to August 1, 1974 --
Procure and manufacture trailers, assemble and test the sampling instruments, meteorological instruments, and data processing equipment previously described. Determine the location of the five trailer sites and the site for the meteorological tower based on preliminary analysis of the physical characteristics of the Tract. Maintain and improve existing roads and/or develop new roads as necessary for the trailer sites. Site preparation for the five trailers and meteorological tower.

Phase II - August 1 to September 1, 1974--

Deliver the trailers, associated instruments and equipment, and the meteorological tower to sites selected. The instruments and equipment will be set up, tested, and calibrated on the Tract. Provide electrical power hook-ups to the trailers and meteorological tower. Verify instrument testing and calibration before such equipment is ready for baseline monitoring.

Phase III - September 1, 1974 to
October 15, 1976--

Measure ambient air concentrations of suspended particulate, sulfur dioxide, hydrogen sulfide, precipitation, windspeed, wind direction, temperature, and humidity at least four trailer locations. Measure the meteorological conditions and concentrations described above, plus ambient air concentrations of methane and total hydrocarbons (calculated as methane), carbon monoxide, oxides of nitrogen, and photochemical oxidants (ozone) at least one trailer location. Measure the wind direction, wind speed, humidity, and temperature at each of the four sensing levels on the meteorological tower. Prepare reports for each station, which reports will contain the following information: (1) a map showing the location of the five trailer sites and meteorological tower on or in the vicinity of Tract C-b, (2) a summary of current Federal and State ambient air quality standards, (3) a tabulation of data summarized in accordance with Federal and State ambient air quality standard averaging periods for each site and collections for the entire sampling network; these averaging periods will correspond to the averaging periods explicitly defined in applicable Federal and Colorado air quality regulations and Federal oil shale lease requirements pertaining to the specific pollutant or meteorological conditions being sampled, (4) statistical description of variation of levels of each sampled pollutant at each site, (5) a substantive evaluation of peak pollutant levels and continuous meteorologic conditions at each site, and (6) tabulation and statistics of wind speed, wind direction, humidity, temperature and precipitation at each site.

Meteorological reports will include: (1) assessments of terrain induced turbulence and its effects on low level flow, (2) stability and lapse rate assessments, (3) relative frequency distributions of wind speed and

and wind direction at each instrument level, (4) evaluation of frictional effects from terrain on the wind field with respect to vertical wind shear, (5) ground level radiation inversions and possible fumigation conditions, (6) measurement of the moisture content and vertical moisture profile of the air, and (7) a summary of calibration and maintenance performed for each piece of equipment during the operating period, including dates of calibration and documented downtime periods for each piece of equipment, if any.

At the conclusion of each 12-month period of data accumulation, an annual report will be prepared containing statistical analyses and graphic presentations. Annual reports, together with any interim reports requested, will be submitted to the Mining Supervisor.

d. Duties of Field Personnel

A factory-trained industrial engineer will regularly inspect all sampling and data collection equipment in accordance with an established written procedure designed to insure that all such equipment is functioning properly. The specific work performed during each inspection will be entered into a master log. Unusual meteorological conditions and any other events which might effect ambient air quality or meteorological data will also be entered into the master log. No smoking or burning will be allowed in or in the near vicinity of the trailers and the ambient air monitoring equipment.

A senior technician supervisor will direct the activities of the industrial engineer. The supervisor will have been trained in specific maintenance and repair procedures of all of the equipment to be used in this program. Both the industrial engineer and senior technician supervisor will be permanently located on or in close proximity to Tract C-b.

e. Additional Studies

The following additional studies will be conducted by the Operator:

i. Analyze particulate collected from the high volume sampler for baseline values of selected trace metals and chemical constituents.

ii. Analyze particulates for particle size range to note any changes in particle size with seasonal weather changes.

iii. In order to determine the best locations for the air quality and meteorological data gathering stations, a preliminary study by a meteorologist will be made to estimate wind patterns, drainage patterns, plume rise and dispersion patterns, and potential temperature inversions on or in the vicinity of Tract C-b. Information from this preliminary study, along with previous meteorological data collected from local weather stations will be used.

iv. A diffusion modeling program will subsequently be undertaken to predict the effect of estimated plant emissions on ambient air quality on or in the vicinity of Tract C-b. This program will likely include upper atmospheric soundings, determination of air drainage patterns and the background of regional and local meteorological conditions to develop a computer diffusion model which can predict incremental pollutant increase in the ambient air.

3. Flora and Fauna

a. General Coordination

The baseline environmental studies for Tract C-b will utilize an ecosystem approach, with maximum correlation of all individual components. This approach will help to insure that the greatest possible amount of valuable information is obtained from the studies done. Employment of organizational procedures from the beginning will minimize future adjustments or relocations of sampling sites, duplication of portions of studies, or missing correlational data. It will also insure a well-coordinated result, and the ability to better describe and understand the ecosystem as a whole, rather than providing only isolated descriptions of individual components of the system. The essentials of a systems approach to accomplish this are outlined below.

A field meeting of all researchers is scheduled before field work begins. Prior to the meeting, aerial site reconnaissance; using fixed wing aircraft or helicopter, or both, will be conducted. At the field meeting, existing maps, species lists and printed studies which the Operator has accumulated, and which the researchers may supplement, will be examined. A ground reconnaissance by the researchers will be conducted as part of the field meeting. A standardization of environmental description will be suggested by the Operator, including: grid system for site location, standard base maps based on scale or scales determined by researchers, correlation of nomenclature for vegetation units and habitat types, correlation of descriptions of climatology of site, and microclimates of habitats.

Data generated by the various research teams will be presented in a form suitable for compilation on computer cards. These cards will provide the basis for correlating the data and statistical analyses. Sample sites will be identified by grid location. The location of sampling sites, especially in the case of locating permanent plots will be coordinated using an interdisciplinary approach. The timing of sample col-

lection will be correlated where relationships are significant and values fluctuate, such as water quality and aquatic ecology. Data collection will be coordinated. For example, one microclimate sample should be used to evaluate soil characteristics, soil microorganisms, vegetation, and animal habitat. In addition to the inventory data gathered on-site, an analysis from a holistic viewpoint will be prepared. This analysis will include a model of the flow of energy on the site and a description of biogeochemical cycles. Data will be collected in such a manner that it will be possible for subsequent work to draw upon these baseline studies. Permanent sample plots will be located precisely so that future monitoring studies and rehabilitation work may be correlated with the baseline studies. Sampling in areas planned for spent shale disposal will be done in order to determine substances present and animals supported before spent shale is placed on the site. Permanent sampling plots will be located in areas which will not be disturbed by exploration and development facilities.

Reports by field research teams will be submitted on a periodic basis to enable the Operator to comply with the reporting requirements set forth in the Lease and the Stipulations.

b. Flora

Studies of the "flora", in strict biological usage, means a description of the kinds of plants which grow in an area. It is desired however, to examine not only the kinds of plants present, i.e., the "flora" of the area, but to describe as well the vegetation of the site, i.e., where and in what combinations the plant species occur. The Operator will, therefore study both the taxonomy (the flora) and the ecology (the vegetation) of the site.

One aspect of the study will be to gather data about the terrestrial ecosystem to prepare the required plan for mitigation of damage to wildlife habitat as required by Section 4 (B) of the Stipulations. This will include information necessary to provide "habitat of similar type and equal in quantity

and quality to that destroyed or damaged", if such is required because significant habitat disturbance occurred.

The study will also gather sufficient baseline data from areas to be disturbed in the future, from which to prepare the Management Plan for erosion control and surface rehabilitation required by Section 10 (B) of the Stipulations. The study will ascertain whether any rare or endangered plant species exist on the Tract.

Alphabetical lists of species, including scientific name and common name, describing location, abundance, and general habitat including exposure, parasites observed, vigor, and date sampled will be prepared. Primary emphasis will be on vascular plants, including angiosperms, gymnosperms, ferns, fern allies, with secondary emphasis on the non-vascular plants, including lichens, bryophytes, fungi, and algae. Vegetation analysis will include a general map of recognizable units of vegetation, and a determination of vegetational community parameters such as dominance, density, frequency, cover, and importance value. The analysis will also include estimates of primary productivity of the site, evaluation of successional status of plant communities, and a determination of heavy metal concentration by plants.

The methods of investigation will include a literature review, and site-wide inventory of plant species, encompassing at least an entire growing season, with a preliminary species list submitted by November 1, 1974.

The sampling program will be correlated as closely as possible with related sampling programs, especially animal analyses. Productivity analyses will be performed in conjunction with the animal ecologists, employing methods such as clip quadrants and browse plant measurements.

c. Fauna

The Operator's zoological baseline studies have the following objectives:

i. To provide data responsive to Section 1 (C) (2) (d) of the Stipulations which require bi-monthly determinations of the distribution and abundance of each species on the Tract and on areas of potential disturbance off the Tract; analyses of ecological interrelationships including migration patterns of birds, mammals and fish and plant-animal relationships. An inventory of natural surface water features, such as springs and seeps will also be prepared.

ii. To gather data sufficient to prepare the Fish and Wildlife Management Plan required by Section 4 (A), to formulate measures for mitigation of significant disturbances to fish and wildlife habitat as required by Section 4 (B), and to develop adequate rehabilitation plans for disturbed areas in accordance with Section 11 (B) of the Stipulations.

iii. To determine the present condition, structure and status of cyclical fluctuations in the population of major species of importance to man. This information will be used to evaluate the relationships, if any, between future changes in population and development activities or naturally occurring causes.

iv. To ascertain the presence and status of any rare or endangered species which may presently exist on the Tract.

In order to accomplish these objectives detailed analyses of the functioning of the food web as a whole will be prepared in addition to those analyses dealing with the distribution and abundance of fauna in the area.

Extensive field work will be conducted to compile species lists according to scientific and common name, location of sighting, and date of sighting. The following specific characteristics will be recorded for the designated groups:

i. Vertebrates (mammals, birds, reptiles, amphibians)

- (A) list of species;
- (B) weight and measurement;
- (C) reproductive state and sex;
- (D) condition including disease or parasite presence; and
- (E) field notes describing habitat.

ii. Invertebrates (arthropods, mollusks and soil organisms of importance to biogeochemical cycles)

- (A) list of orders represented (or families in the case of insects), or the lowest taxonomic level necessary to provide meaningful population data;
- (B) specific information regarding presence of vectors of disease, parasites, important herbivores and important links in the food web.

4. Aquatic Ecology

These studies will gather sufficient data about the functioning of the aquatic ecosystem to formulate the required Fish and Wildlife Plan and procedures for mitigation to damage to fish habitat. Information required in order to provide habitat equal in quantity and quality to any destroyed or damaged will be obtained.

The Operator will ascertain the correlations between present water quality and existing aquatic species, including seasonal variations. The study will also determine whether any rare or endangered species of fish exist in the streams surrounding the Tract area.

The fish data will include a species list, location and date sampled, weight and measurements, reproductive state, if applicable, and condition. The population information will include estimates of abundance of species, estimates of numbers/trophic level, age/size ratios, determination of habits of migratory species, and evaluation of habitat in terms of availability, extent, and quality.

The macro-invertebrate data will list orders and families represented, and information regarding presence of vectors of disease, parasites, potential pests, and important links in the food web. Quantitative sampling will be conducted to determine numbers/unit area and biomass/area. Analysis of seasonal comparisons of diversity and abundance will also be performed.

A list of algae species will be prepared. Species diversity will be analyzed. Determinations of relative abundance of chlorophyll content will be made. Primary production will be estimated.

Bacteria will be generally analyzed. An attempt will be made to determine the abundance of potential disease organisms and correlate any increase in bacteria species with water quality data.

Investigation will include literature review and interviews with personnel of agencies and institutions, as well as local citizens, to establish a list of possible species to expect. An initial site survey

and inventory of streams, springs, and seeps will be made to ascertain variety of habitat types, Sampling will be correlated as closely as possible in site location and timing with the water quality sampling program.

The sampling will be adequate in number and location to determine any changes in aquatic ecology which could be attributable to the development of Tract C-b. Springs and seeps on the leased property are to be sampled for aquatic organisms which may be present. This data will be coordinated with existing water quality data. Specimens are to be collected only as necessary for successful completion of difficult taxonomic identifications, and for periodic checks to ascertain physical condition, fertility, and the presence of internal or external parasites. Rare or endangered species will not be collected.

5. Soils Survey and Productivity Assessment

A soil survey and productivity assessment will be conducted on all portions of the Tract where development disturbance is expected in compliance with Section 1 (C) (2) (e) of the Stipulations. In order to be able to restore a self-perpetuating, equivalent vegetative community on those sites disturbed during exploration or development activities, the characteristics of the soil which are vital in supporting plant community will be studied.

a. Chemical Properties

- i. Elemental analysis (spectrography, spectrophotometry, or comparable methods)
- ii. Mineralogical analysis
- iii. Cation-exchange capacity
- iv. Hydrogen-ion activity (ph)
- v. Soluble salts
- vi. Nitrogen (total, inorganic, organic, gaseous)
- vii. Carbon (total, organic, carbonate)
- viii. Organic matter

b. Soil Water

- i. Total water content
- ii. Water diffusivity
- iii. Water capacity
- iv. Water availability
- v. Evapotranspiration

c. Physical Properties (other than soil water relations)

- i. Porosity
- ii. Composition of soil atmosphere
- iii. Temperature
- iv. Particle size distribution
- v. Bulk density
- vi. Clay analysis

d. Structural-engineering Properties

- i. Consistency
- ii. Compactibility
- iii. Stress distribution
- iv. Shear strength
- v. Volume change
- vi. Modulus of rupture
- vii. Penetrometer measurements
- viii. Bearing capacity
- ix. Aggregate stability

Productivity will be determined by means of bioassay. Soil microbiology analysis will include plant and animal organisms, and will be correlated with plant ecology. Laboratory culturing will be utilized, as necessary, for identification.

6. Scenic Resources

The Oil Shale Lease requires the Lessee to consider existing aesthetic values in all planning, construction, reclamation and mining operations. All operations, including, but not limited to, design and construction of roads, pipelines and transmission lines, shall, where practicable, be performed so as to minimize visual impact, make use of the natural topography, and to achieve harmony with the landscape. In order to be able to meet these requirements, it is necessary to determine the type and quality of the scenic resources presently existing in the Tract C-b area. The purpose of this study is characterize the major scenic elements of the Tract as they are related to the overall scenic resources of the surrounding area, and to define and evaluate areas of visual sensitivity on the Tract.

The scenic resources will be described for the region surrounding the Tract. Major scenic elements will be enumerated and a qualitative assessment will be made. A visual evaluation defining and designating areas of sensitivity will be made. This evaluation will also include recommendations for methods of minimizing visual impact. Descriptions of on-site resources visible from major transportation corridors will be set forth. Photographs of representative visual elements as seen from major transportation corridors will be taken and retained. In order to evaluate the visual sensitivity of Tract C-b, it is necessary to estimate viewer-time levels, uniqueness, and visual importance to region.

7. Historic and Scientific Values

Since the precise location and extent of land to be used has not been established at this time, a surface archaeological study of the entire Tract is planned. The discovery of sites, if any, containing articles of historic, archaeological, or scientific interest which cannot be "appropriated, removed, injured, defaced or altered" may limit land areas available to use. The Operator recognizes the need to ascertain this information at the earliest possible time, and will accomplish this objective by inspecting all areas of the Tract during this study. The study will recommend actions to be taken in areas of historic, archaeological, or scientific interest, based on evaluations of the significance of any discoveries made on or near the Tract.

The surface studies will include the entire Tract, and any land outside of the Tract which may be disturbed. Maps will be made of significant sites, if any. The study will describe sites and catalogue any articles found. The significance of sites discovered will be evaluated and a recommended course of action will be set forth. The investigation will consist of a literature review, an aerial photographic study, and a surface survey of the entire Tract, and additional land which might be disturbed. If recommended, excavations will be made to determine the significance of sites to be disturbed by development activities.

C. Roads, Trails, and Other Necessary Facilities

1. Roads and Trails

The additional short road section which will be required for the core drilling program was described by the Operator in the Plan previously filed. The Operator anticipates that its exploration activities will require only limited improvements to existing roads and trails. The Operator's road improvement plan will involve as little environment and surface disturbance as possible while providing an adequate means of transporting sensitive instruments and data processing equipment to on-site sampling locations.

Access and on-site requirements will be the subject of continuing analysis in connection with the corridor plans to be prepared in compliance with Section 2 (A) of the Stipulations. Total on-tract requirements cannot be determined until final sites for the air quality and meteorological monitoring stations have been selected. Any new or improved roads or trails will be constructed, operated, and maintained in accordance with Sections 1 (F), 2 (B) through (D), 2 (J) through (M), 9 (D) through (F), and Sections 11 through 13 of the Stipulations.

2. Other Necessary Facilities

In addition to the air and water monitoring structures described above, certain temporary facilities will be required on or near the Tract to support the necessary field activities as follows:

- a. Office space for approximately six personnel.
- b. Laboratory facilities encompassing approximately 300 sq. ft. to support environmental monitoring programs. Equipment included in these facilities are items such as drying ovens, balances, laboratory tables, and distilled water supply.
- c. Approximately 400 sq. ft. of storage space for samll equipment, cores, etc.
- d. Electrical power and telephones.

e. If zoning regulations permit, temporary living facilities will be provided for limited numbers of Operator's personnel who occasionally are required to stay on or near the site. Temporary facilities will be provided for cooking, eating and sleeping. In addition, the Operator proposes to set up a temporary expanded camp to accommodate a maximum of 20 researchers from June to August of 1974, when intensive environmental baseline field operations will be conducted.

f. Shower and sanitary facilities will be required, together with a waste disposal system approved by the Mining Supervisor, pursuant to Section 14 (B) of the Stipulations.

g. A maintenance area must be provided for vehicles, a bulldozer, and a grader, which are required for road maintenance and transportation.

h. Five trailer sites are necessary for the air quality and meteorological monitoring stations.

i. A security service trailer site is required at the main access road to the Tract.

Such facilities will be located near the center of the Tract or on private lands along Piceance Creek. The final site choice must necessarily depend upon discussions with county officials concerning zoning requirements, as well as upon availability of power and field reconnaissance work.

Prior to final site selection for any environmental monitoring facilities, drilling facilities, or support facilities, the proposed sites to be used for those purposes will be inspected by qualified scientists to assure that no rare or scientifically significant species, objects of historic interest, or special features such as springs, will be disturbed. The Mining Supervisor will be immediately informed if any such species or objects are found. The investigating scientists will recommend methods of mitigating any environmental impacts which might be anticipated as a result of the construction or operation of support facilities. They will also document the nature of the existing environment in order to assist in restoration and rehabilitation of disturbed areas.

Operator expects to locate support facilities on relatively flat terrain in proximity to the main roads, insofar as possible. Security personnel at the site access will keep a log of all activities on the Tract in order to assist in the interpretation of any anomalies which may occur in baseline environmental data.

Office and laboratory space may be either trailers and/or portable buildings. No more than two or three acres are expected to be disturbed by the installations presently proposed. However, a site which will allow for future expansion with minimum further environmental damage will be chosen.

All permanent structures will be painted in accordance with Lease Stipulations, and any necessary signs will be prepared in accordance with the Lease Stipulations.

To the extent possible, the site will be selected to minimize land disturbance caused by roads, power, and telephone lines. All construction and operations will be conducted in accordance with applicable county zoning restrictions, as well as the Lease Stipulations. Support facilities will not be located in the proximity of air quality monitoring stations.

3. Other Surface Disturbances

a. Rehabilitation Research Plots

The Operator intends to conduct studies to determine the most effective methods for rehabilitating and revegetating disturbed areas on the Tract. In connection with these studies, the Operator will utilize revegetation and seed plots which may or may not be on-site. These plots will be selected on the basis of varied vegetation types, soil conditions, solar exposure and climatic conditions; among other things. These studies are a necessary prerequisite to preparation and implementation of rehabilitation and revegetation plans.

b. Water Impoundment

Quantities of ground water will be brought to the surface as a result of drilling and pump tests necessary to determine accurately the characteristics of existing aquifers.

Core drilling operations at each drill site will produce varying quantities of ground water. The Operator intends to use an air mist to remove cuttings. The use of drilling mud could cause impregnation of fractured aquifers and thus interfere with subsequent pump tests and water quality sampling. As water-bearing zones are penetrated, ground water will flow into the drill hole and be forced out of the hole by air. The quantity and the quality of the water forced from the drill hole will depend upon a variety of factors including the depth of the hole, the number of water-bearing zones penetrated by the bit, the permeability of penetrated aquifers, the presence of fractures in aquifers, and the quality of the water contained in each aquifer. The influence of these factors at each site cannot be determined precisely until the specific core hole has actually been drilled.

The Operator plans to discharge ground water with low dissolved solids to the Tract's natural drainage system. Based on water quality samples taken during previous drilling operations in this area, Operator expects that some of the ground water produced from the deep aquifers will contain relatively high levels of total dissolved solids (TDS). The Operator has considered various methods for disposal of this water: 1) permitting surface evaporation or percolation back into the ground, 2) collecting the water in an impoundment, and 3) on-site treatment and disposal into the Tract's natural drainage system. The Operator has tentatively selected the second alternative approved by the Mining Supervisor. The feasibility of on-site treating is subject to being investigated. The Operator will mitigate the impact of each impoundment by removing top soil from the base of the impoundment site to construct the crest of the impoundment dam. Reclamation will then be achieved by regrading the bottom of the impoundment with the same top soil and revegetating after the impoundment water has evaporated.

D. Cross-Country Travel

To the extent that the Operator's exploration activities will necessitate the use of on-site vehicles and construction equipment, the physical effects of the use of such equipment are discussed herein. The Operator intends to restrict on-site vehicular travel to the extent practicable and to confine such travel to existing roads and trails whenever possible. The principal on-site vehicular activity will consist of the moving of core hole drilling equipment and personnel, the installation and servicing of baseline data collection stations and equipment, and on-site travel of environmental research teams.

E. Research Operations

All initial research operations which could potentially disturb the Tract are described in detail in this Plan. In the event that the need for additional on-site research should develop, the Operator will file appropriate amendments to this Plan with the Mining Supervisor.

F. Seismic Work and Blasting

At the present time, the Operator believes that the sub-surface geological data gathered from past and future core hole drilling programs should provide an adequate basis for determining the extent, quality and location of the oil shale reserves beneath Tract C-b. As a result, the Operator does not anticipate any pre-development seismic work will be necessary. In addition, no other programs have been planned which would involve the use of explosives until preliminary mining activities are commenced. At that time the Operator intends to comply fully with Section 5 (c) of the Stipulations relating to use of explosives.

G. Drilling

The Operator's core hole drilling program was previously described in the initial Exploration Plan entitled, "Core Drilling and Associated Ground Water Program", filed with the USGS on April 10, 1974. Further detail relating to use of these core holes, to

obtain sub-surface hydrology data, is discussed in Section IV B. 1. b. of this Plan. In addition, affirmative programs designed to avoid or mitigate environmental damage from the drilling program is included in Sections IV A, IV C and IV D.

V. INITIAL FISH AND WILDLIFE MANAGEMENT PLAN

Before any portions of the land are disturbed, plant and animal investigations, archaeological and aquatic investigations as previously outlined will be undertaken in order to determine the conditions of sites proposed to be disturbed. In the event that any areas are found to be ecologically or archaeologically unique, exploration activities will be relocated to the extent practicable. These areas will be revegetated after exploration activities are completed to their pre-existing condition, insofar as this is possible.

During the baseline environmental data collection phase, investigators will be instructed to minimize killing and collecting of animal species. Any rare or endangered species which may be discovered in the area will definitely not be collected or harmed under any circumstances. Species lists and population data will be collected to the greatest extent possible by utilizing such means as sightings, signs, tracks, inspection of hunter kills, etc. No potentially harmful substances such as dyes or radioactive tracers, will be utilized in connection with the environmental baseline studies.

Prior to the initiation of any drilling or other exploration work on the Tract, animal ecologists will establish methods to minimize any expected impact on wildlife caused by the activities planned. Personnel involved in exploration activities will be given instructions concerning possible methods of avoiding adverse impacts on wildlife. Such methods will include noise reduction, timing of activities, proper use of vehicles, and minimization of surface disturbances.

Additional information is needed concerning the types of species present on the Tract, their utilization of habitat, the intensity of this utilization relative to habitat areas off of the Tract, and the degree of dependence on specific onsite areas, before a detailed Management Plan can be formulated. All precautions will be taken, however, to insure that vital habitats are not disturbed while the baseline studies are being conducted. The compilation of substantial data relating to the tract area and its ecology is necessary before an intelligent and thorough Management Plan can be formulated.

VI. EROSION CONTROL AND SURFACE REHABILITATION PLAN

In connection with the programs discussed in this Plan, there will be disturbances of portions of the surface of the Tract. The disturbances will include (1) site preparation for core hole drilling, (2) site preparation for air quality and meteorological stations, (3) vegetation and soil plots, (4) site preparation for office, laboratory, and housing

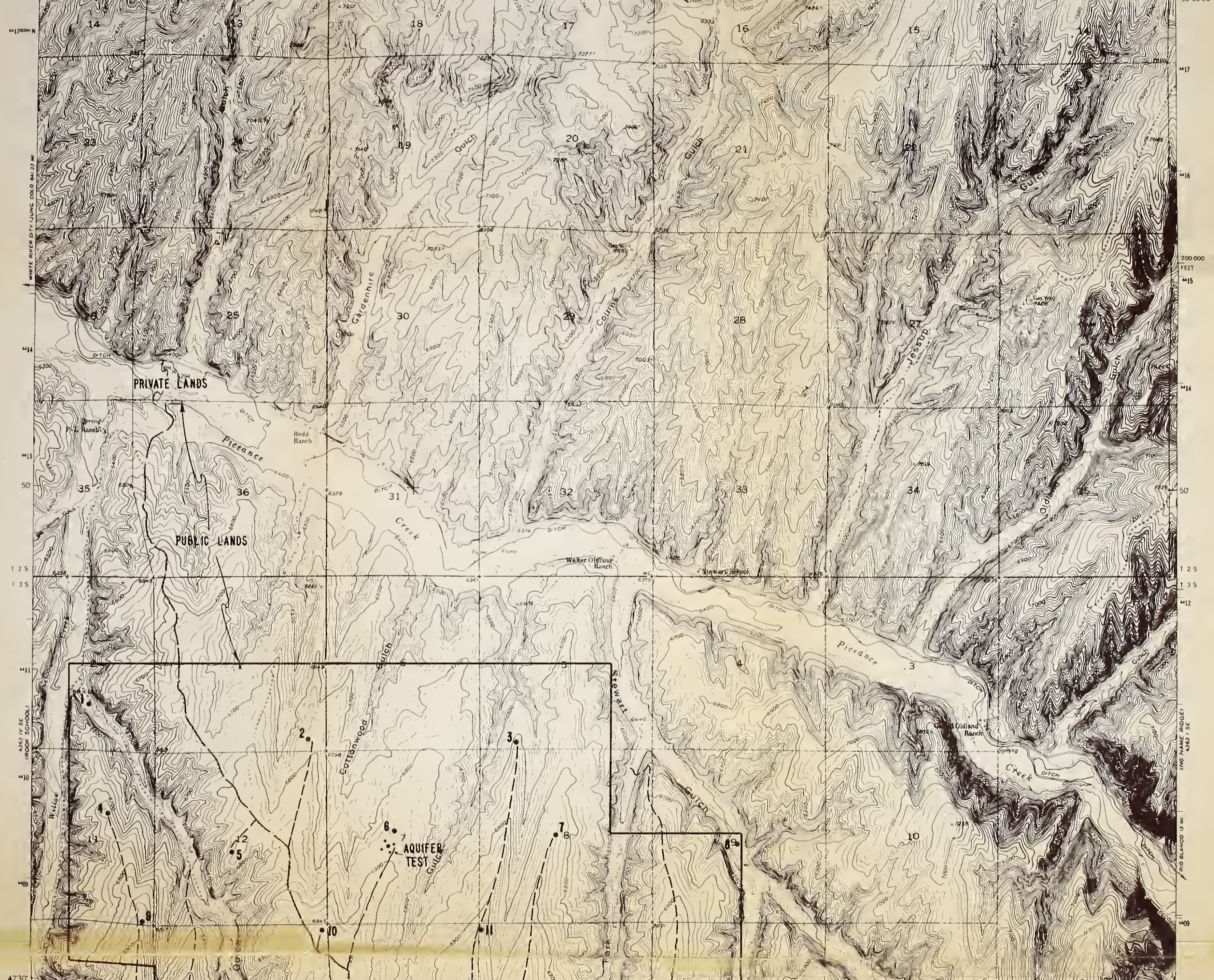
trailers, (5) impoundment sites, and (6) road and trail improvements. Many of these disturbances will not result in soil erosion.

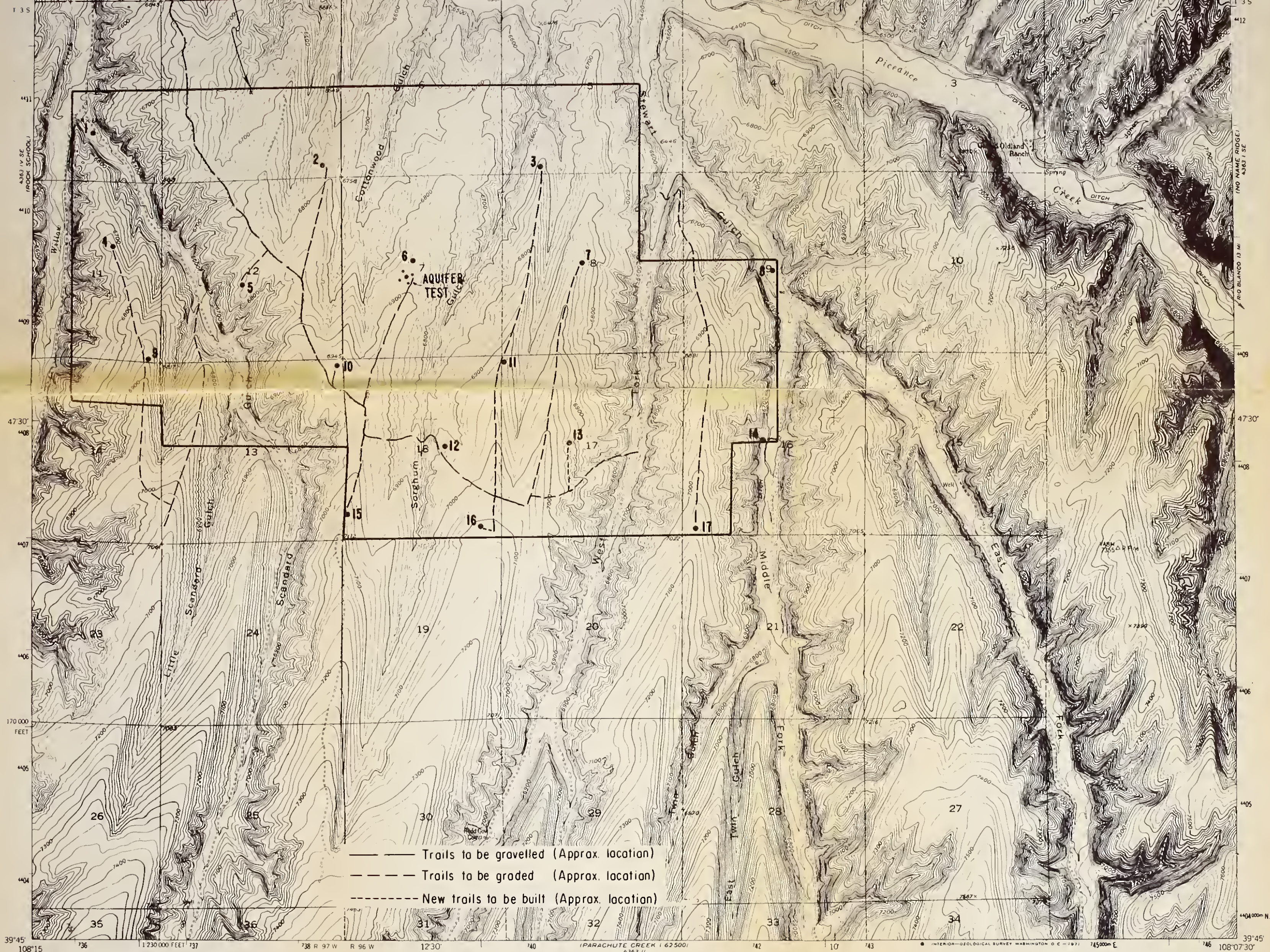
To the extent that core holes are drilled and tested, there will be water brought to the surface which will require control. The water will be prevented from flowing uncontrolled on the surface of the Tract. Road improvements will result in some exposed, disturbed surface, therefore precautions will be taken to insure that such surface is not significantly eroded. These controls will include, where necessary, drainage ditches or culverts to divert or channel water runoff control facilities, the Operator will limit their construction or utilization except where necessary. All disturbed areas will be reseeded as soon as possible.

The first step necessary to rehabilitate disturbed areas to a "usable and productive condition consistent with or equal to pre-existing land uses in the area and compatible with existing, adjacent undisturbed natural areas" is ascertaining the existing community types and conditions of the sites before they are disturbed. This is a primary purpose of the pre-exploration environmental investigations which will be conducted on each site prior to any disturbance. These initial studies, along with the detailed baseline monitoring studies will provide information necessary in order that disturbed sites may be restored, as close as possible, to a condition equal to that prior to disturbance.

Any techniques to be used in the rehabilitation of disturbed sites will be submitted to the Mining Supervisor for approval. Recognized experts in the field of rehabilitation of disturbed areas, such as the Soil Conservation Service and State agencies, will be consulted.

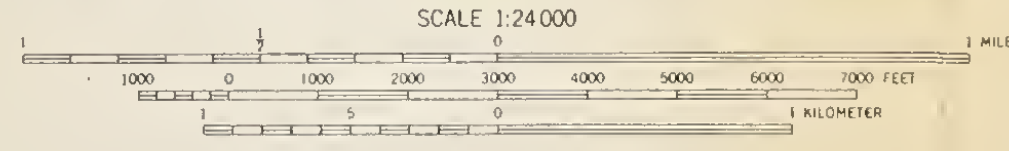
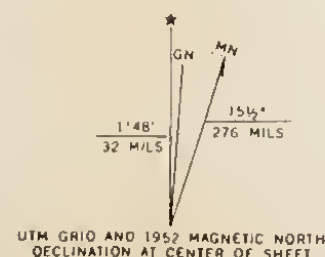
108°15' 108°00' E 108°15' 108°30' 108°45' 108°00' W 108°15' 108°30' 108°45' 108°00' W 12 30 39 40 41 42 43 44 1 260 000 FEET 108°07' 30' 39°52' 30'



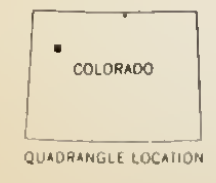


- Trails to be gravelled (Approx. location)
- - - Trails to be graded (Approx. location)
- - - New trails to be built (Approx. location)

Mapped, edited, and published by the Geological Survey
 Control by USGS and USC&GS
 Topography from aerial photographs by multiplex methods
 Aerial photographs taken 1948. Field check 1952
 Polyconic projection, 1927 North American datum
 10,000-foot grid based on Colorado coordinate system
 north zone
 Dashed land lines indicate approximate locations
 Certain land lines are omitted in T 3 S - R. 96 W.
 because of insufficient data
 1000-meter Universal Transverse Mercator grid ticks,
 zone 12, shown in blue



CONTOUR INTERVAL 20 FEET
 DATUM IS MEAN SEA LEVEL



ROAD CLASSIFICATION

Heavy-duty	4 LANE, 6 LANE	Light-duty
Medium-duty	4 LANE, 6 LANE	Unimproved dirt
U.S. Route		State Route

JESSUP GULCH, COLO
 FIGURE 2
 1952

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
 FOR SALE BY U.S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR WASHINGTON, D. C. 20242
 A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

ER'S CARD

1974 C-3

the prototype
tract C-b

	OFFICE	DATE RETURNED

(Continued on reverse)

